DECEMBER, 1961

PLASTICS
THE MAGAZINE OF APPLIED ENGINEERING
TECHNOLOGY

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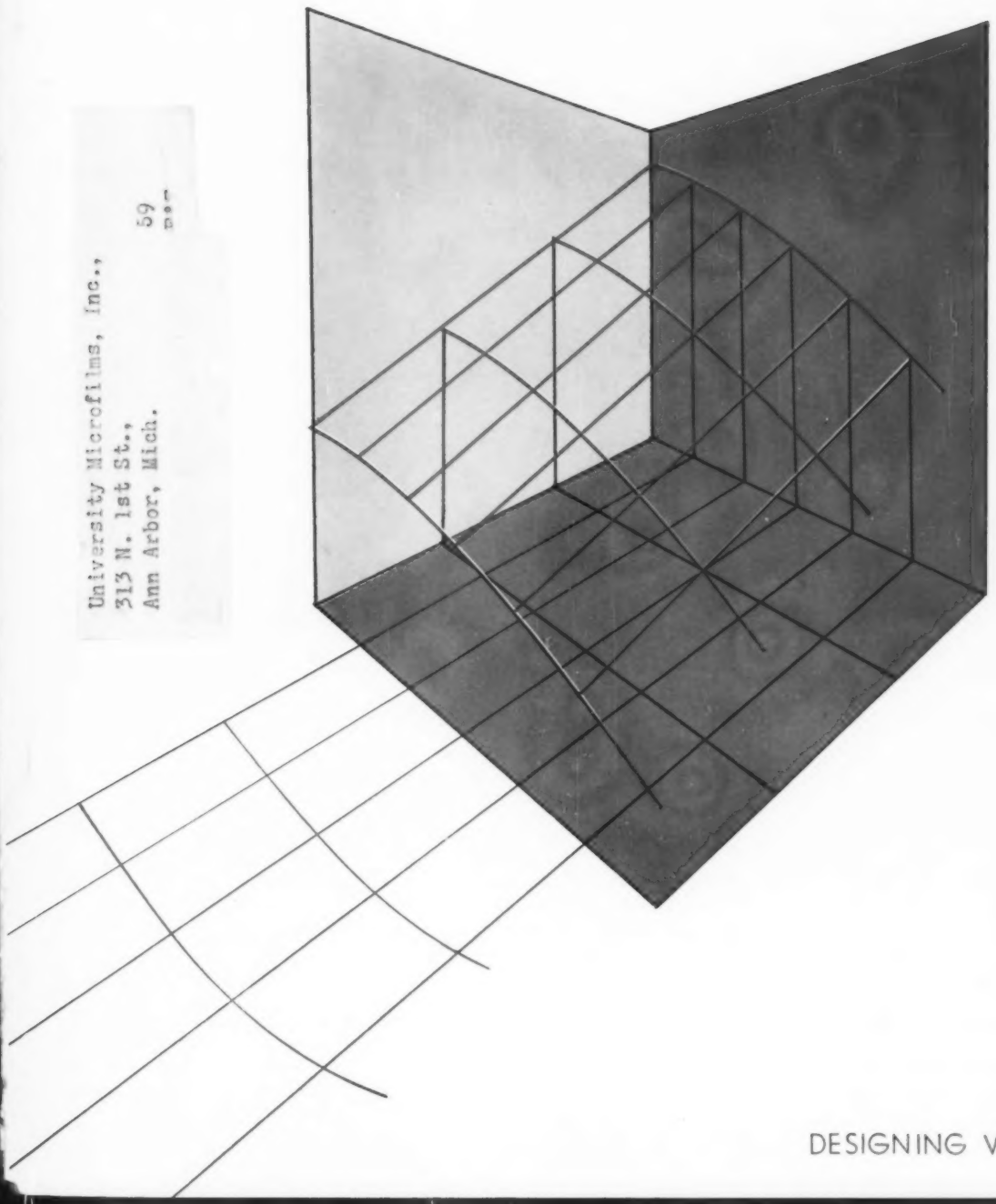
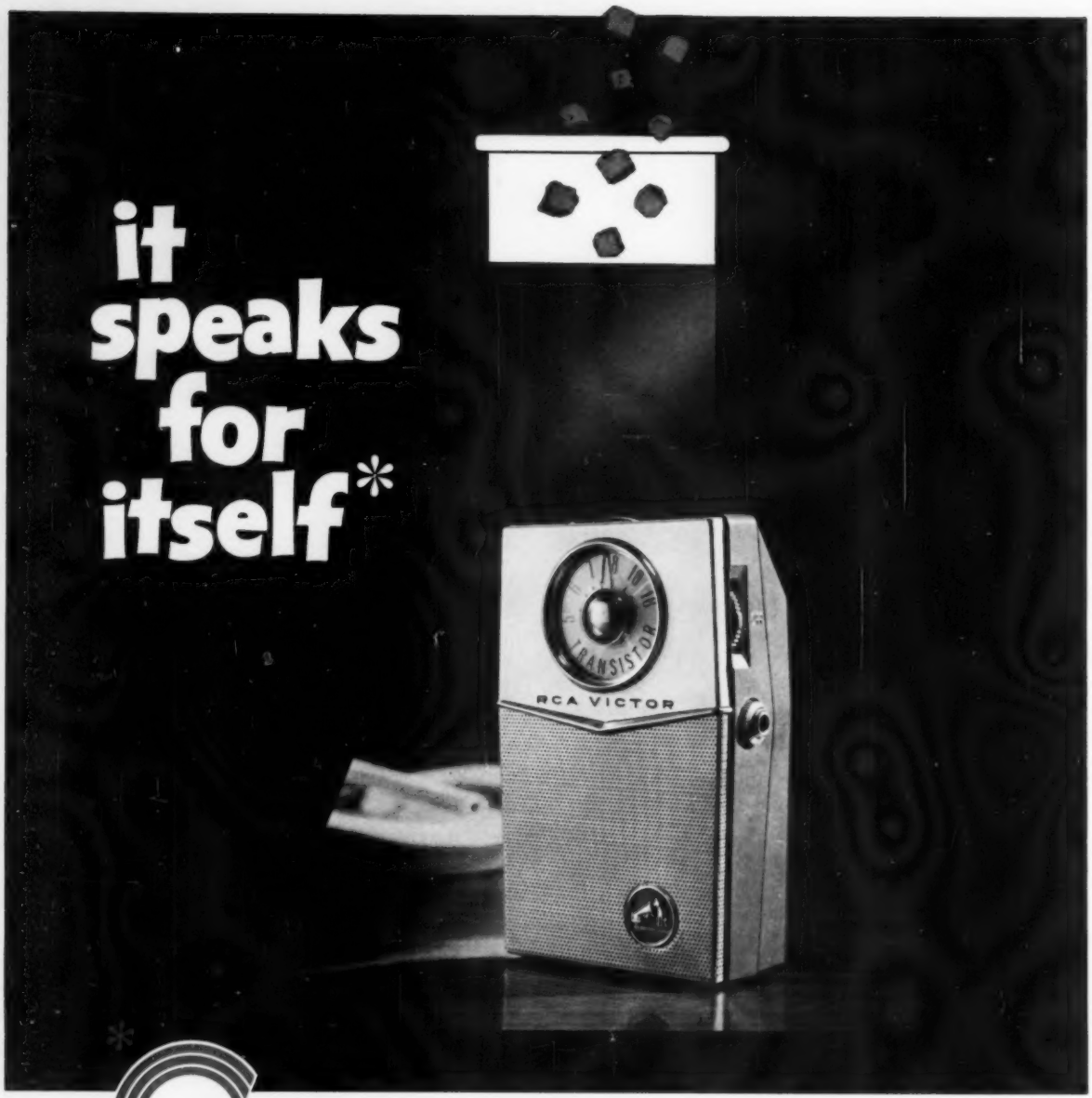


DESIGNING WITH PLASTICS



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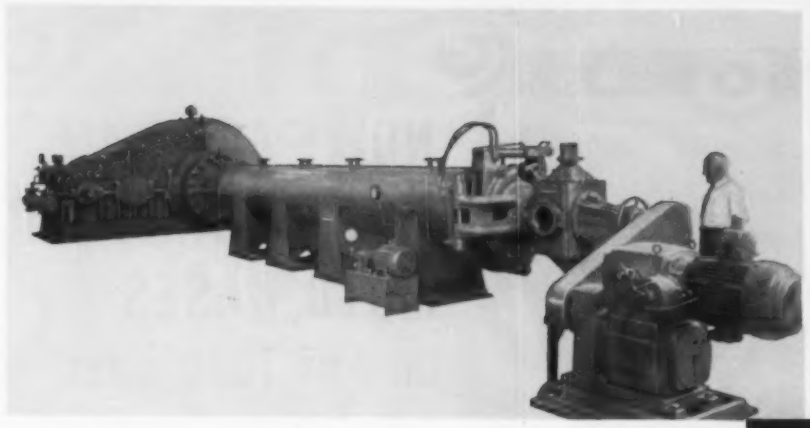
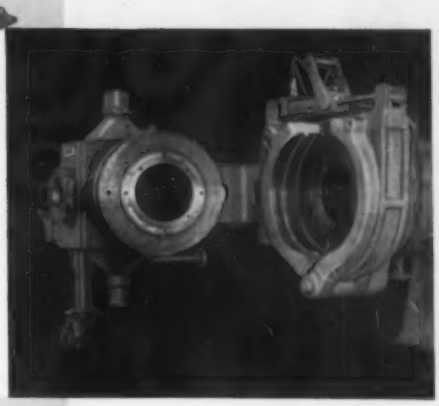


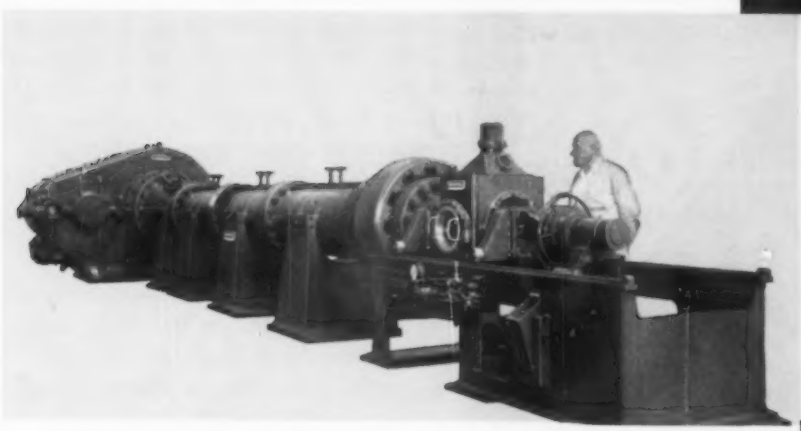
The machine at left is one of the largest underwater pelletizers ever built. Equipped with a 15" screw that is 30' long, it is driven by a 2000-hp motor and is designed for 10,000-psi working pressure. The head (shown open in the illustration below) is equipped with a hydraulic-clamp locking device.

Two examples of

underwater pelletizers

developed by Farrel for high-capacity extrusion





This cold-feed polyethylene extruder is driven by a 1500-hp motor and Dynamatic drive with a top speed of 100 rpm. Designed for head pressures of 10,000 psi, it is equipped with a long throttling ring. The head is mounted on rails so that after unlocking it can be quickly withdrawn.

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Among Farrel's important contributions in the field of plastics processing has been the development of underwater pelletizers. While the two examples given are high-capacity machines, smaller extruders with underwater heads are also available.

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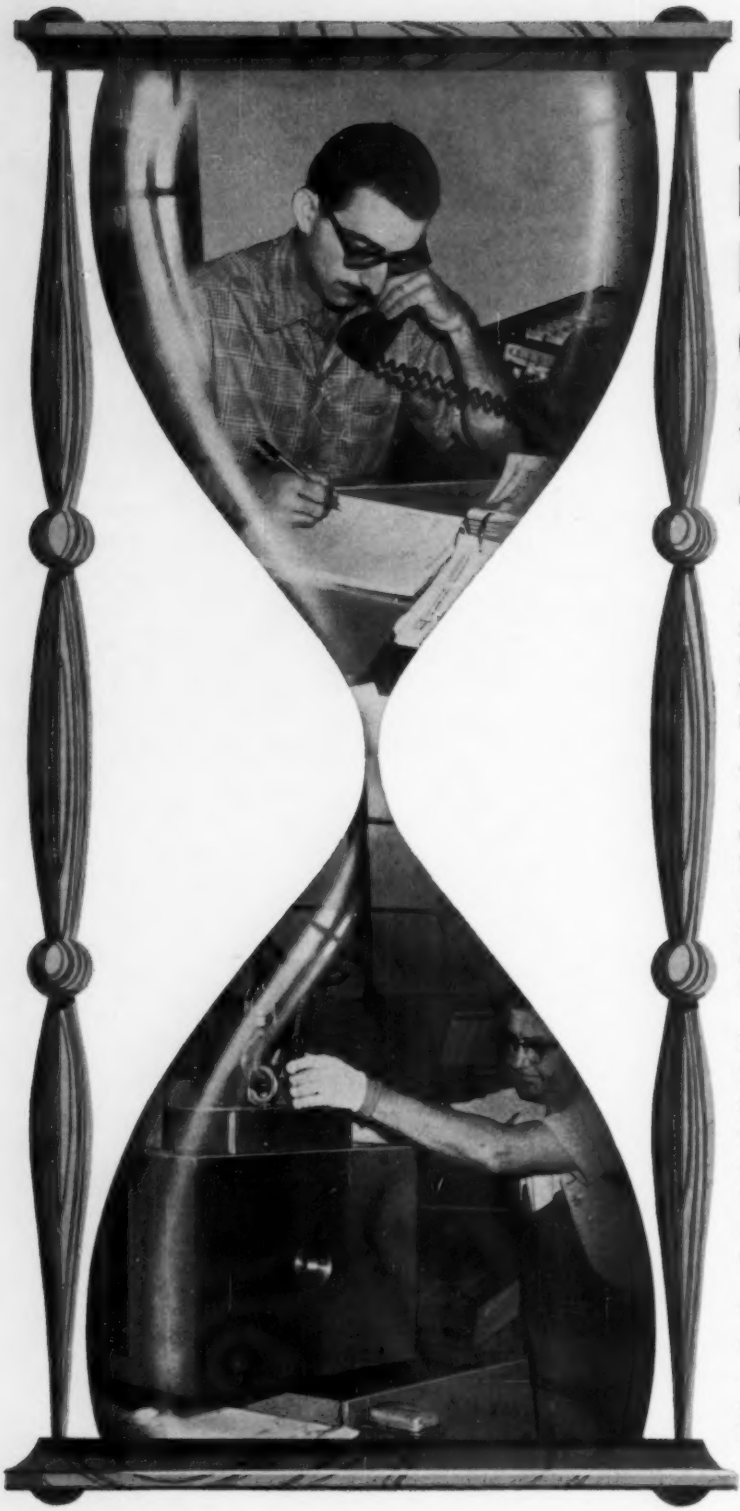

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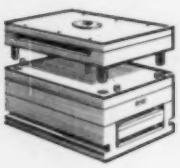

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Artist George Booth's rendition of a trimeric graph into three dimensions.
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the authors

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Dr. Schmitz has a 1949 Ph.D. in organic chemistry from Ohio State University and has been with G. E. for 12 years, four of them in his present position. He has numerous articles and patents in the polymer field to his credit and is at present editing a book, *Testing of Plastics*, for Interscience Publishers.

•

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•

C. HOWARD ADAMS [*Plastics Standardization in the U. S.*] is manager, product engineering, Monsanto Chemical Co., Plastics Div. He received his B. S. in chemical engineering in 1939 and his M. S. in mechanics in 1945 from the University of Illinois. He is the author of some 25 papers on plastics materials engineering and has been very active in plastics work in ASME, ASTM, and ISO/TC 61. He is also a member of ACS and AIChE.

•

DONALD F. DEW [*The Custom Molder vs. the Captive*] received his B. S. in business administration from Northwestern University in 1948. He is executive vice president of Diemolding Corp., and president of its Hubbard Industries affiliate. Mr. Dew was with U. S. Rubber Co. and Poole Brothers Printing Co. in administrative capacities before joining Diemolding. He is a director and head of the custom molders division of SPI.

Letters to the editors

ABS Instrument Panels

Sirs:

In your September issue, in your New Applications, Pg. 61, you refer to the 1961 Dodge Lancer instrument panel cluster as being molded of Cycolac ABS. In reading your description, it is easily assumed that you are speaking of the entire instrument cluster housing. The 1961 Dodge Lancer employed a zinc die cast instrument cluster housing with a decorative metallized bezel molded in Cycolac.

The only complete instrument cluster housing in production in ABS today is on the 1961 and 1962 Buick Special. This is molded in Kralastic K-2938, a special high temperature, high tensile strength ABS produced by Naugatuck Chemical.

R. F. McCabe, Automotive District Mgr.,
Naugatuck Chemical Div.,
U. S. Rubber Company
Detroit, Mich.

Fiberglass Fabrication

Sirs:

Would you be able to advise whether fiberglass panels can be shaped into straight curves and made to retain this curve?

Would you please put us in touch with the manufacturers of spray-guns and spray systems for use with fiberglass to apply rovings or chopped glass?

H. S. Schumeister
Nebraska Feed Products
Plattsmouth, Neb.

(Fiberglass panels cannot be reshaped once they are rigid, but can be shaped into various curves during manufacture. The material, prior to setting up, will conform to any mold configuration.)

Surface application coatings

Sirs:

We are very interested to obtain detailed information on the use of epoxy resins and/or polyester resins presently used for surface application coatings such as walls, structures, insides of tanks, ships, boats, roofs, etc., the equipment being used for the application by painting or spraying on, and the anticipated future growth of the aforementioned applications.

Any information you will be able to convey to us would be much appreciated.

Rolf A. Merton
New York, N. Y.

(In his reply, Lee Zukor, our Engineering editor, suggested that the inquirer contact Carboline Co., St. Louis, Mo.; Amercoat Corp., South Gate, Calif.; and Porter Paint Co., Louisville, Ky., for direct information. These materials as paints can be brush-coated for small area work, and be hot-sprayed or solvent-sprayed. These protective coatings have replaced some of the so-called acid-proof coatings in industrial plant use.—Editor)

Film Properties

Sirs:

We would appreciate very much if you would advise whether there have been any recent articles in your publication comparing the properties of oriented and non-oriented polypropylene film.

A. D. Bercow
Robeco Chemicals, Inc.
New York, N. Y.

(In a separate letter, the inquirer was given a suitable list of articles.)

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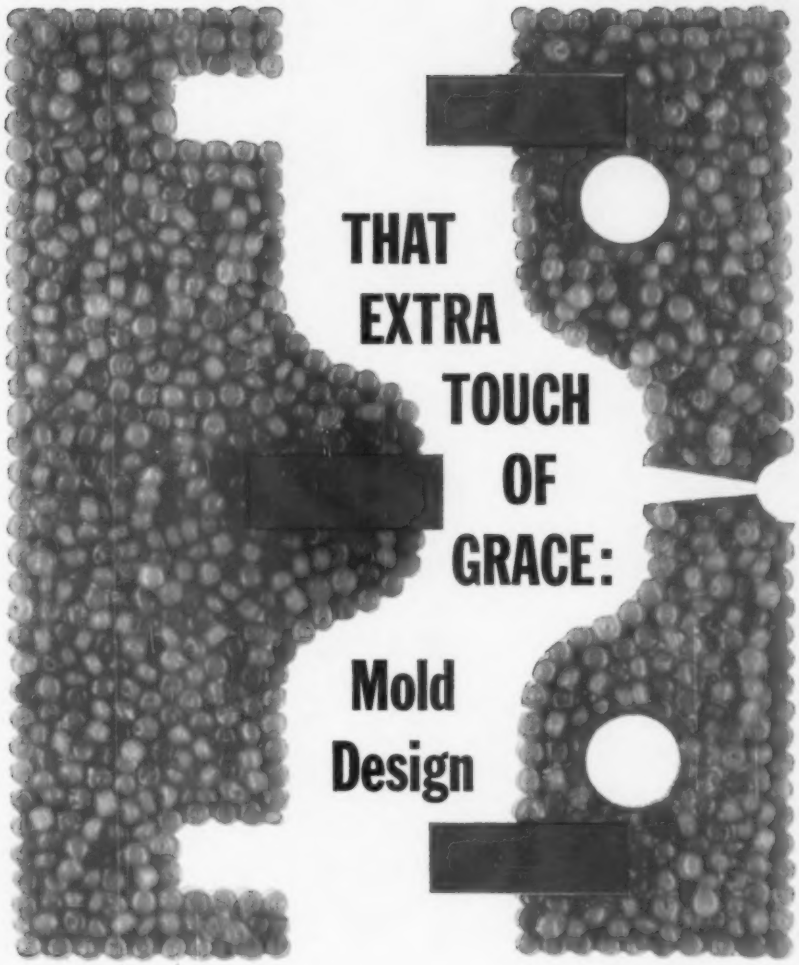

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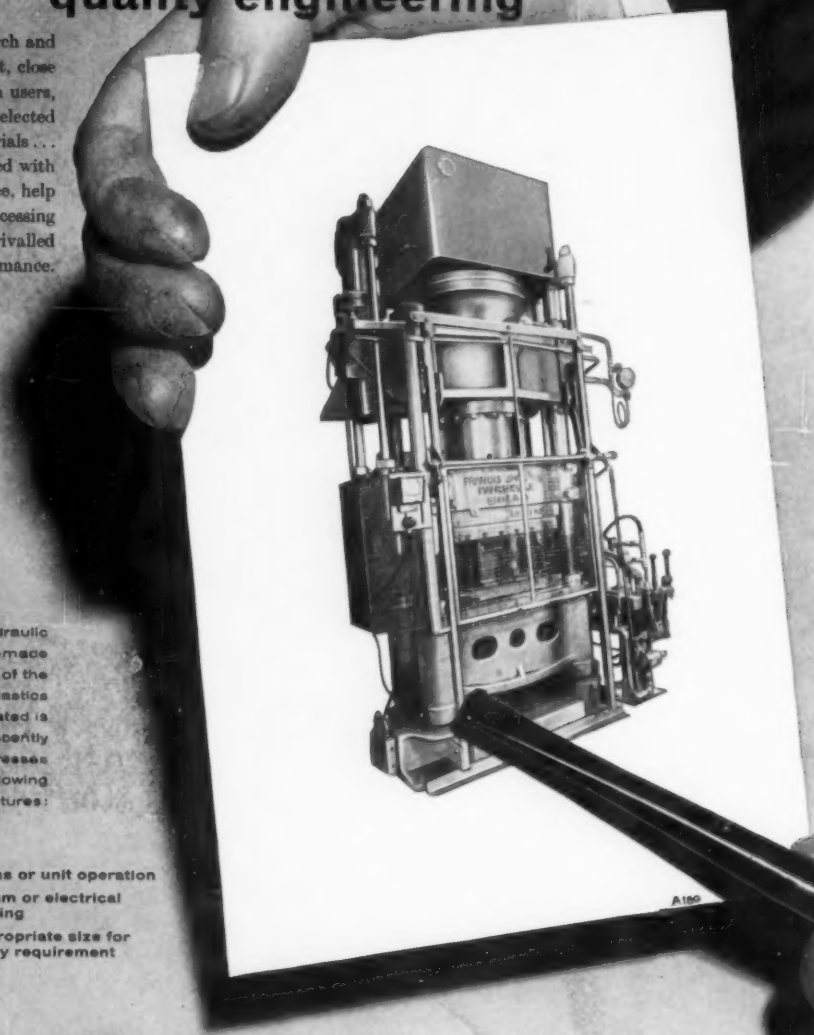

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OVERSEAS AGENTS THROUGHOUT THE WORLD P4451

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editorial:

PLASTICS TECHNOLOGY presents to its readers this month, if not a new face, a new expression. We are a shop magazine, our finest pages are those that help you do your job better. We believe that reading those pages can be pleasant as well as informative, and that pleasure arises from reading a concise, clear and well-told story. It also arises from a well organized page.

We offer this issue as a beginning in an evolution that will make PLASTICS TECHNOLOGY easier to read and more pleasant to look at. Our articles will in general be shorter, though no less informative; their pace faster; our illustrations larger. Some articles will seem longer—actually, they will be those that we would previously have published in two or more parts.

To brighten the page and speed the pace of our articles, we are incorporating the information heretofore found in footnotes into the text, and carrying references to the end of the article together with a selected bibliography.

We will print our graphs and charts in a larger format to make them easier to read; and we will treat them artfully, because there is beauty in the precise elegance of a chart or a graph.

We are instituting an Authors' Column, which will consist of brief biographical sketches of the men who write our articles. Our articles will continue their emphasis on new ways in plastics, on designing and engineering new products for plastics applications.

We are starting our editorial matter further forward so that you can get into the magazine sooner. And while we are not printing ads on editorial pages, we are interspersing them between articles, thus to give the eye a rest and the reader a change of pace as he reads through the magazine. We are eliminating *carry-backs*, the continuation of an article further back in the book.

These are changes that we have effected with this issue. We may not have done them as they might best be done, but we have started the evolution.

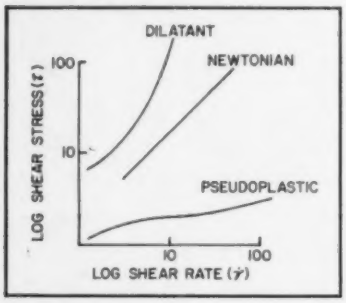
In the final analysis this means more manpower: more editors to report, edit and write, artists to design, specify and layout. Our masthead will keep you apprised of developments on that score in the coming months.

We invite your participation in our evolution. We invite your comments, your complaints, your suggestions.

$$\eta = \frac{\tau}{\dot{\gamma}}$$

NEWTON AND THE NON-CONFORMIST FLUIDS

Newton's classical hypothesis, stated above, provides a basis for the study of viscous flow. However, many viscous fluids behave in a non-Newtonian manner. In polymer melts, for example, viscosity may vary with pressure and flow rate. These properties must be measured — with accuracy — in order that their behavior may be predicted in advance. Knowledge of flow behavior assists the researcher in studying molecular structure . . . helps the engineer in designing more efficient process equipment. Which is why we're using this space to tell you about the new Instron Capillary Rheometer, a valuable and versatile new tool for studying the behavior of polymer melts and other non-Newtonian fluids.



Newtonian fluids have constant viscosities with shear stress proportional to shear rate. Dilatant fluids show an increase in viscosity while pseudoplastics become more fluid at higher flow rates.

Designed for use in INSTRON Tester

The new Instron Capillary Rheometer (Type MCR) consists of an extrusion assembly mounted on an Instron Universal Tester. Temperature controls are contained in a separate cabinet. A sample of polymer or other non-Newtonian fluid is forced out through a capillary by a plunger driven by the moving crosshead of the INSTRON.

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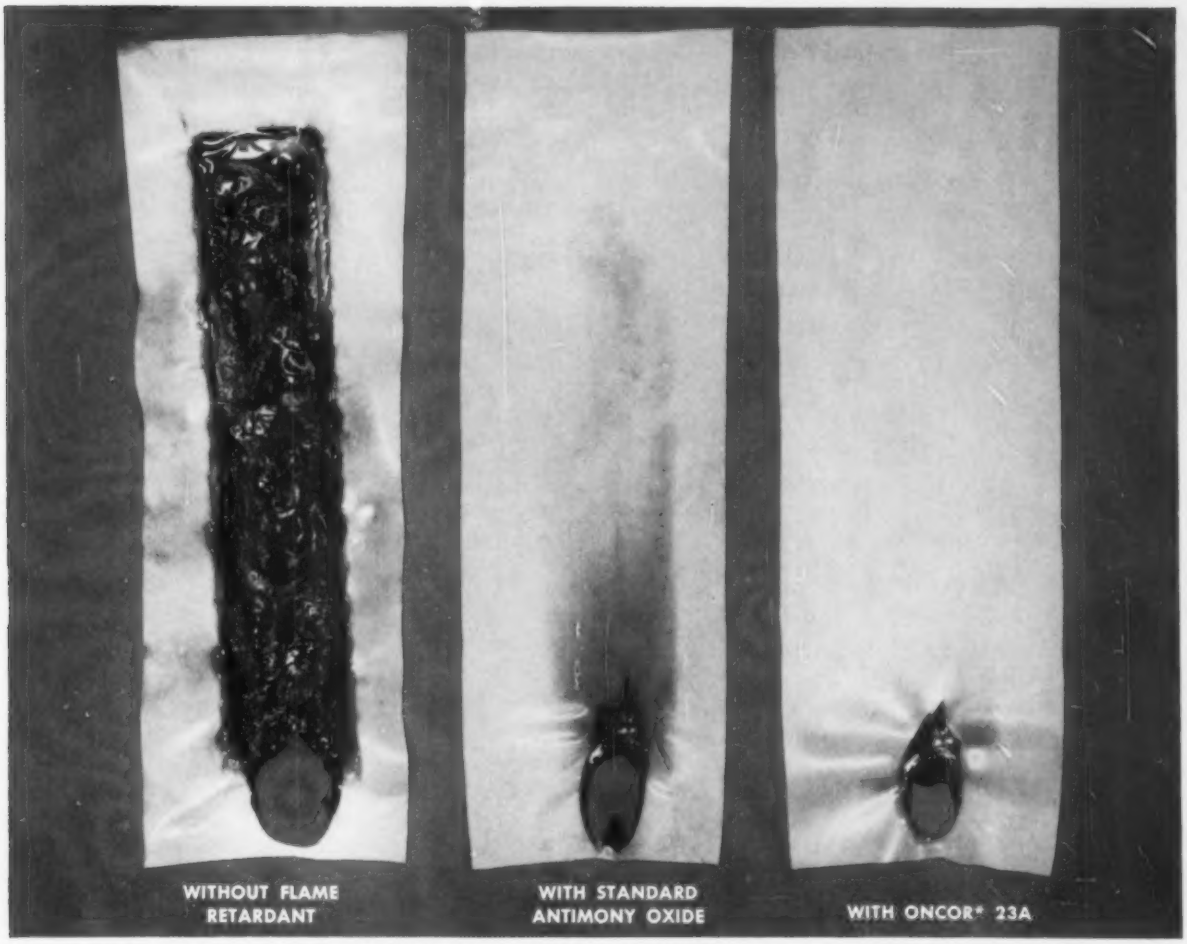

Typical results of recent flammability tests on 6 mil PVC film, following ASTM Method D 1433-56T. Antimony oxide and ONCOR 23A used at 5% level (resin basis)

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Dispersion is easy and uniform in plastics and paints. ONCOR 23A pigment particles are unusually uniform — the result of careful production controls.

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Processing News

Rods, tubes and extrusions of complicated shapes of phenolic or epoxy thermosetting plastic made by an unusual European process, now being developed in the United States, are available in limited volume from York Industrial Plastics, Inc., York, Pa. Continuous production in any length is possible. The molding powder, which is a filled or unfilled Bakelite compound especially formulated by the Union Carbide Plastics Co., is rammed into the cool rear section of a special die by a horizontal ram extruder. Successive strokes of the ram introduce a series of charges which force the material further into the die. A rising temperature gradient is maintained, and at a predetermined point the material becomes fully plastic. An extended portion of the die provides a curing zone. The extrusions are plastic as they leave the die, and, if desired, can be permanently curved.

York expects the phenolic extrusions to compete with paper-based, phenolic laminates. Extruded items have greater compressive strength, about two-thirds the flexural strength and better electrical properties when wet than laminates. They are 25 to 50% cheaper than equivalent laminated items. Extruded phenolics are also expected to compete with aluminum extrusions, since they are cheaper on a material basis than aluminum. Built-in color and lower thermal conductivity offer additional advantages in window framing and storm sash.

Extrusion of thermosets is naturally slower than for thermoplastics. Compared with laminating, however, thermoset extrusion is faster and wastes little or no materials. The design of extrusion dies is critical, and if close tolerances are required, allowance for thermal shrinkage must be made. Tolerances of ± 0.4 percent of cross section can be met.

Rigid three-dimensional relief maps with minimum increase of weight are being made by Aero Service Corp., Philadelphia, Pa., who support their maps with prefoamed polyurethane blocks fused to the epoxy backing material with a layer of polyurethane foam spread on the backing. The use of Isotron fluorinated hydrocarbon blowing agent (Pennsalt Chemicals Corp.) in the spread foam eliminates the need for gas generating equipment. The polyurethane foam cannot be poured over the entire area of the backing, however, because shrinkage during curing would distort the contours of the map, making it useless. Instead, a portion of the map is supported with a prefoamed polyurethane block, it is set in a layer of working foam spread on the backing, after the foaming action ends the area is trimmed and leveled and the next foam block is set adjacent to the foamed area and the process repeated.

A removable plywood and metal frame with drilled holes confines the foaming action and controls density. As a final step, an epoxy fiber glass laminate is placed over the polyurethane core, thus providing a stable, lightweight but strong sandwich-type construction for the maps. The maps are widely used in government and industry.

Any kind of metal pipe can be lined with uniform, pore-free coatings of chemically resistant plastics to give an exceptional bond without adhesives by a process available on license from Engelhard Hanovia, Inc., Newark, N. J. The firm, which does not itself produce pipe, resin or equipment, will supply technical knowledge, pilot plant data, and consultation on plant design and operation.

The new process includes cleaning the pipe, preparing its surface by conventional methods, and then heating it to the melting point of the resin used. Fusing of the plastic to the pipe takes from 6 to 50 seconds, depending upon the resin used and the thickness desired. When required, secondary heating, annealing and/or quenching follow. Coatings can be applied in thicknesses of 5 to 60 mils. In its pilot plants, Engelhard Hanovia has lined steel and aluminum pipes up to 30 feet long and from one to four inches in diameter. They estimate that their system can line pipes up to 14 inches in diameter.

Almost all thermoplastics can be used in the process, including chlorinated polyether (Penton), Teflon 110 FEP, nylon, PVC, high density polyethylene, epoxies, and cellulosics. The flow properties and particle size of each resin determined the thickness necessary to achieve freedom from voids.

Equipment used in the chemical, oil, food and paper processing industries can also be lined by the new process. Combined pre-treating and application costs, exclusive of resin costs and royalties and licesing fees, range from 10 to 25¢ per square foot.

For more information check Readers' Service Card No. 108→

You name it—

glossy, flat, opaque or translucent whites

GLIDDEN ZOPAQUE®
TITANIUM DIOXIDE

can give you the special white finish you want

Salesmen, sales managers and other marketing people know the big difference the *exact shade* of white can make. On the retail counter, gloss, flat or striking "blue" whites have different appeals . . . can make or break consumer reactions.

So marketing, as well as production and technical men, are learning the values of Glidden *Zopaque* Titanium Dioxide. *Zopaque* can be counted on to give *certain* optical qualities for high opacity, hiding strength and tinting power.

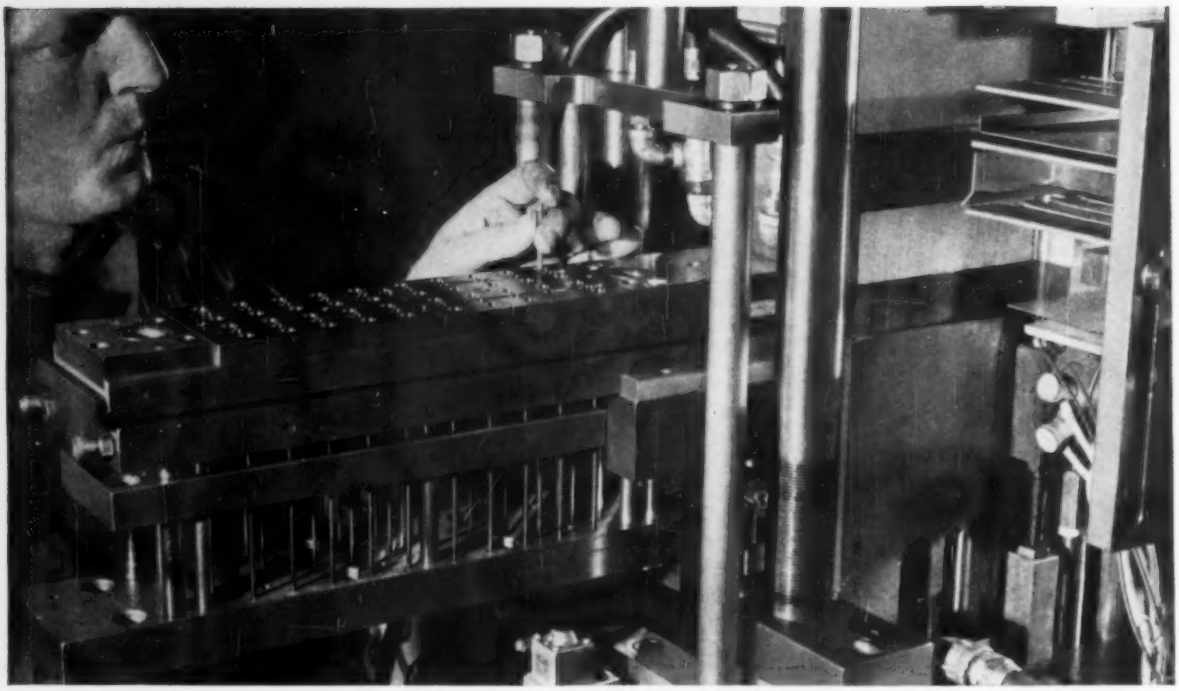
It can pay you well to find out how Glidden *Zopaque* Titanium Dioxide can help to sell your products. Write or call:

QUALITY Glidden PRODUCTS

THE GLIDDEN COMPANY
FINEST PIGMENTS FOR INDUSTRY
Chemicals Division • Pigments and Color Department
Baltimore 26, Maryland

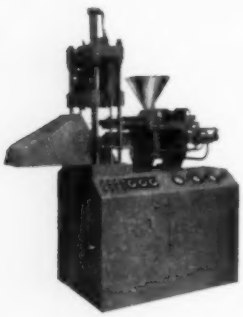
(This advertisement is printed on paper stock containing Glidden *Zopaque* Titanium Dioxide.)

NEW from Stokes!



#701-S SHUTTLE INJECTION MOLDING MACHINE SPEEDS **TWO-COLOR** AND INSERT MOLDING

Stokes announces a new shuttle molding press which cuts precious "press open" time from 2-color and insert molding. Now, the labor savings of Stokes automatics have been combined with the time saving advantages of a shuttle type injection machine. Molding, degating, ejecting, stripping and sorting are all done automatically.



OVER 60% LABOR REDUCTION IN TWO-COLOR MOLDING...

- The Stokes 701-S automatically molds, degates, separates and discharges the first color *inserts ready for second color molding.*
- With a flick of a switch and a simple mold change, the 701-S is ready for molding the second color.

The only manual operation for insert molding is loading . . . everything else is done automatically. Net result: more production time and less press idle time.

For two-color or insert molding the Stokes 701-S is *flexible* and fast . . . puts insert loading at your *fingertips* for greater *labor savings.*

For information on the latest in two-color molding techniques and automatic insert molding, consult Stokes.

Plastics Equipment Division **STOKES**

F. J. STOKES CORPORATION • 5500 TABOR ROAD, PHILADELPHIA 20, PENNA.

Stokes International: Philadelphia • Toronto London

For more information check Readers' Service Card No. 109

DOWN!

COMES THE PRICE OF PFIZER ITACONIC ACID AND ESTERS

Pfizer brings the price of Itaconic Acid (technical grade) down to 34.5¢/lb.*, and reduces Itaconic Acid (refined grade), Dimethyl Itaconate and Dibutyl Itaconate to 39.5¢/lb.* ■ Now these highly efficient monomers can be economically used for an ever-widening range of industrial applications. For example: ■ Itaconic Acid, with its unique structure—a beta-carboxyl group separated from the polymer chain by a methylene group—imparts specific adhesion to selected substrates and improves emulsion stability. ■ Dimethyl Itaconate is of particular interest as a comonomer for improving heat distortion temperatures, toughness and weathering in molding compounds. Both Dimethyl and Dibutyl Itaconate are effective comonomers for improving the weathering characteristics of protective coatings. ■ Write today for full details on the new low prices and the growing uses for the Pfizer family of Itaconates.

CHAS. PFIZER & CO., INC., Chemical Division, Brooklyn 6, N.Y.

*Carload quantities f.o.b. our plants. Less-than-carload prices also down. Investigate!

Science for the world's well-being

Pfizer

CHEMICAL DIVISION
Industrial Chemical Development Dept.

For more information check Readers' Service Card No. 110

NEW
PRICE DECREASE

for the Industry's Best Low-Temperature Vinyl Plasticizers

Premium Performance of Plastolein® Azelates Now Available at Lower Price

Now, more than ever, you can benefit from the outstanding cold weather performance of Emery's Plastolein Low-Temperature Plasticizers. The recently announced price reductions bring azelate prices to an all-time low. Earlier price decreases this year followed last spring's drop in alcohol prices and the opening of Emery's new ozone oxidation plant.

Plastolein 9058 DOZ—Unequalled Low-Temperature Performance, Now 39c

The price of Plastolein 9058 DOZ has been dropped 2c to a new low of 39c per lb. (tankcars, East of the Mississippi). Long recognized as the outstanding low-temperature plasticizer, Plastolein 9058 DOZ offers great versatility in vinyls. It can be used as the sole plasticizer in applications requiring the most severe low-temperature performance because of its excellent compatibility. And its low volatility enables vinyls to maintain their low-temperature flexibility over extended periods of time.

In addition to the superior low-temperature properties which it imparts, Plastolein 9058 DOZ makes possible luxurious softness, drape and "hand" in vinyl film, sheeting and, especially, in coated fabric. It is this combination of outstanding hand, drape and low-temperature properties that is responsible for the wide use of 9058 in the new vinyl foam fabrics. 9058 also has excellent heat and light stability, low water extraction and unusually low soapy water extraction.

Plastolein 9078 LT—Azelate Advantages, New Lower Price

Plastolein 9078 LT has been reduced an additional penny to 35c per lb. Yet, it features azelate permanence: low volatility, good resistance to oil extraction. Its low-temperature performance approaches that of DOZ.

Other Azelate-Based Plasticizer Prices Reduced

Price reductions extend to the other Emery plasticizers derived from azelaic acid. Plastolein 9057 DIOZ, similar to Plastolein 9058 DOZ and also an excellent low-temperature plasticizer for vinyls, is now 39c. Plastolein 9050 DHZ, which has wide use in high clarity applications such as vinyl film and sheeting, has been lowered to a new 45c level. DHZ is exceedingly compatible and efficient, allowing total plasticizer content to be reduced.

Complete Technical Data and Evaluation Samples

May we suggest that you make an analysis of possible advantage to you from using Plastolein Low-Temperature Plasticizers—especially in the light of these new and significant price decreases. Tangible upgrading of product quality or better costs, or both, are the rewards. Write for evaluation samples and complete technical information.

NOTE: All prices quoted in this advertisement are for tankcar quantities, delivered east of the Mississippi. Slightly higher prices apply for smaller quantities and to more distant locations. All prices are subject to change without notice.

Emery

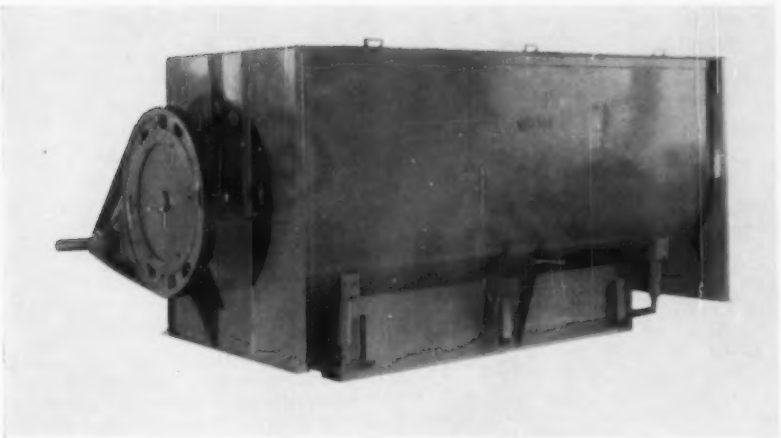
Organic Chemicals Division
EMERY INDUSTRIES, INC.

Dept. Q-12, Carew Tower, Cincinnati 2, Ohio
Vopcolene Division, Los Angeles, California
Emery Industries (Canada) Ltd., London, Ontario
Export Division, Cincinnati

For more information check Readers' Service Card No. 111

New Equipment

Service Item numbers refer to numbers on Readers' Service Card facing page 78.



Drop-bottom ribbon blenders

A series of drop-bottom ribbon blenders, in capacities from 24 to 191 cu. ft., which permit complete discharge the moment optimum quality blend has been achieved, are being offered by Munson Mill Machinery Co. Drop-bottom gates may be as large as the entire bottom of the blender or with smaller openings, if desired.

Munson ribbon blenders are featured by an all-welded twin steel spiral ribbon agitator assembly. One moves the batch from left to right, the other from right to left and both keep the whole mix in constant rotary motion. The assembly is securely bolted to heavy steel journals *outside* the mixing drum by thick companion flanges. The agitator assembly can be removed or replaced with little effort. The heavy steel drum main body of the blender requires no cross trusses to support the walls, and makes for easy cleaning and repair. External packing glands, combined with a gasket-tight cover provide for dust-free operation. The exterior steel journals, welded to the companion flange, are carried in heavy ball-bearing pillow blocks. The drive unit on larger models has a counter-shaft arrangement utilizing roller chain drive from counter-shaft to element shaft. Torque arm reducers mounted on counter-shaft or arranged for connection from counter-shaft to gear head motor are available as an option. Smaller models have torque arm reducers mounted on ribbon element shaft for V-belt connection to motor.

In addition to the drop-bottom models, center slide gates, end-located slide or paddle gates, and iris gates for metered discharge are available. *Item 21*

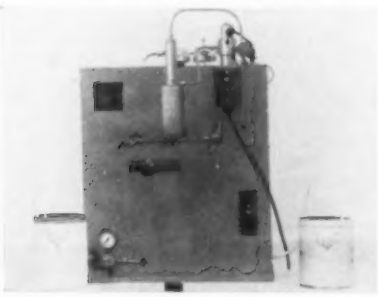
Air Compressor Drying Unit

Increased output of clean, dry air from compressors or reduced horsepower per 100 CFM of air processed is obtained in almost any climate by use of the Coblentz Dry Air System of Lynch Corp., Air Systems Division. Intake air is filtered and forced under slight pressure into the Coblentz unit where it is chilled and dried by automatically controlled refrigeration. Large amounts of cool, potable water are removed from the air before compression, thus delivering a greater weight of air to the compressor while at the same time virtually eliminating oil-water sludge in the delivered compressed air and the problem of water vapor corrosion of the equipment in which the air is used.

In the 3000 CFM installation illustrated a 3 H. P. fan forces filtered air into the Coblentz unit where a 26 ton capacity refrigeration system (coils only in unit) is capable of reducing 98°F. air to 38°F. for delivery to the compressor at a positive pressure of two inches. Over 15% gain in delivered volume of compressed air can be obtained at no increase in compressor horsepower or, conversely, when plant compressed air usage remains constant, air compressor horsepower can be reduced at least 15%. Dry, clean air with as low as 4% relative humidity at optimum point of use temperature can be obtained. The cold intake air insures safe compressor discharge and line temperatures.

The Coblentz Dry Air System can be used to advantage in any industry employing compressed air in machines, tools, mixing and conveying equipment, and in all single and multi-stage compressors from 350 CFM up, in any climate in the world. *Item 23*

Push-button mixer/dispenser for reactive resins



The Mark II/25 machine for use with reactive resins such as epoxies, polyesters, polyurethane foams and others, has been developed by the Leal Corp. With the Turvort mixing head, the Mark II/25 shot-type machine can dispense one or more shots of mixed material by actuation of a pushbutton or other electrical trigger. An air motor drives two plunger pumps simultaneously to deliver the proper proportions of resin and hardener to the mixing head. The machine can dispense up to 25 cc. of resin per shot at any required ratio from 1:1 to 1:25 with an error in ratio less than 0.1% and at pressures up to 5000 psig. The liquid viscosity range that can be handled is from 10 to 50,000 centipoises, and with auxiliary equipment any flowable fluid can be used.

The Mark II/25 may be employed for jobs as varied as potting or encapsulation of electronic components, casting shoe heels from urethane elastomers, molding gears from rigid urethane or polyester materials, supplying setting compounds for brush bristles, and dispensing reactive adhesive materials for cementing. *Item 22*

Modular injection machines

A new line of "building block, modular constructed" plastic injection molding machines, which makes possible the selection of many different combinations of long stroke adjustable toggle clamps and injection units, has been announced by Moslo Machinery Co. Equipment is available in seven basic, fully automatic models from a one ounce high speed container machine up to and including 6-8 ounce machines. All clamps are adjustable from a minimum of 5 inches to a maximum of 12 inches with adjustable slowdown on both ends as well as adjustable cushion. Plasticizing capacities range from 60-125 lbs. per hour and clamps from 85-200 tons. The printed electrical system features plug-in relays, limit switches and timers. A new, compact manifold simplifies the entire hydraulic system and the entire power pack is easily accessible even though enclosed in the frame away from dust and dirt. *Item 24*

New Equipment *(Cont'd.)*

Versatile surface pyrometer

The new PYRO surface pyrometer announced by the Pyrometer Instrument Co. is a completely self-contained, portable, compact, rugged and quick-acting instrument for the accurate measurement of surface and sub-surface temperatures. It is available with a selection of 12 different types of thermocouples and a rigid or a flexible extension arm for measuring the temperature of any metallic or non-metallic, flat or curved, rotating or stationary surface. It can be equipped with a new quick-chance connector which permits the thermocouples to be snapped and locked onto the extension arms in a second, with no tightening needed. Thermocouples are interchangeable without adjustment or recalibration. Another exclusive feature is the new PYRO lock-swivel by which thermocouples may be locked at an desired angle without danger of their jarring loose in use.

Model 31 illustrated is equipped with the flexible extension arm and the mold or lava type thermocouple for measurement of the temperature of molds, dies, platens, etc. It has a large 4¾ inch direct reading dial, with a scale reading from 0-400°F. Other models are available with ranges as follows: 0-300°F.; 0-600°F.; 0-900°F.; and 0-1200°F. In addition double range models may be obtained. These instruments are equipped with automatic internal cold end junction compensators as standard equipment.

The various thermocouples available include the roll or band type for measuring temperatures of mill or calender rolls, the mold or lava type mentioned above, the prod type for any clean metallic surfaces, the needle type for plastics and rubber, and the immersion type for liquids, gases, and molten soft metals.

The new PYRO surface pyrometers are shock, dust and moisture-resistant and the shielded meter housing is designed to withstand rouge usage. *Item 25*

Bulk-material conditioner

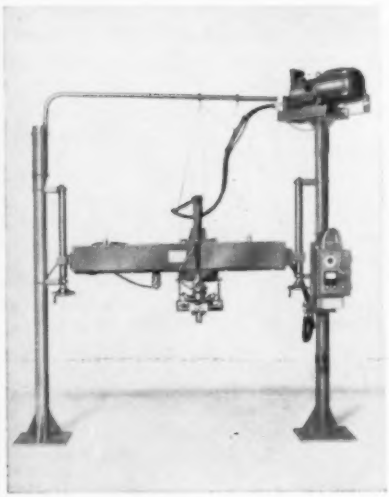
A new bulk-material conditioner called the Verticone mixes the desired amount of liquid into a continuous stream of finely divided or granular material. It has been developed by the Johnson-March Corp. for making a stream of material dust-free; introducing a specified moisture content; color identification of the material; or coating granules of finely divided material. The conditioners also have wide application wherever dust collectors must be unloaded in such a manner that the fine particles can be packaged or hauled away without loss.

Materials to be treated are fed at a uniform rate (±5%) into a cone at the top which causes the material to form a circular, falling curtain as it leaves the base. Spray headers at the base of the cone disperse any liquid into the material in the precise proportion desired. From 150 pounds to 150 tons of material per hour can be handled on a continuous flow basis. If desired, further mixing of the liquid and solids can be made after discharge from the Verticone. *Item 27*

Traverse for foam mixing heads

Screw-adjust Model AT41S air operated traverse mechanism, adjustable in height, stroke, and traversal rate, for pouring polyurethane foam over large areas, has been developed by Martin Sweets Co. This rotary type, air-driven prime mover has a starting torque up to 30 ft.-lbs. with a consumption of 40 cfm. of air. The stroke is adjustable from 12 to 48 inches, control valves allow fine adjustment in speed from 1 to 4 ft./sec., and dependable roller bearings support the carriage which cannot jam at stroke limits, even if limit controls are removed. Smooth reciprocation is assured through natural cushioning of the air system. Foam dispensing nozzle can be set from ground level to five feet.

Model AT41S includes air shutoff valve and traverse speed control valves, mixing head drive platform and mounting, foam panel brackets, regulator, filter, lubricator, slings for hoses and drive shaft. *Item 26*



20-oz. screw plasticizer type injection molding machine

The new Farrel Watson-Stillman S-20-350 horizontal in-line screw plasticizer type injection molding machine has a fully hydraulic clamping mechanism with slow clamp closing speed for accurate die setting, and a self contained hydraulic operating system with the oil reservoir mounted directly above the clamping cylinder for more efficient filling of the clamp cylinder and a reduction in floor space requirements.

The screw plasticizer, a Farrel Watson-Stillman design, utilizes a standard extruder complete with a gear box and hydraulic motor with infinitely variable screw speed which is mounted in a saddle sliding on two tie rods which serve as ways. The tie rods are supported at each end by a support yoke, which yoke, at the nozzle end, includes a hollow plunger and

rotary shut-off valve and nozzle assembly. The hollow plunger and nozzle assembly telescope into the end of the extruder. Two hydraulic cylinders, mounted on the other end of the support yoke can move the extruder in either direction. The entire assembly rides on the bed ways as an injection unit.

In operation the screw advances plasticized material to the front end of the chamber, filling the space between the end of the screw and the stationary plunger; material under pressure causes the extruder to move back against controlled hydraulic presssure until it hits the positive stop, which operation provides a measured shot between the screw and plunger. To make a shot, the hydraulic cylinders push the extruder ahead causing the extruder barrel to telescope over the fixed plunger, which displaces the plasticized material through the hole in the plunger and nozzle into the die.

The heat treated alloy steel screw has nitrided flutes. For general purpose use, a 15:1 length to diameter ratio and a 3.2:1 compression ratio with 7/16 of an inch flight depth screw is used. In general, all the commonly used plastic materials, except rigid PVC, can be run on one of three standard screws. A special screw can be provided for rigid PVC.

Control instrument voltage is 110. Three wire service is all that is required to connect the machine (220 or 440 volt, 3 phase, 60 cycle current). All timers are the plug in type.

In connection with the clamping mechanism, the front safety gate has both hydraulic and electric interlocks which prevent the clamp from closing while the gate is open. In addition, the rear safety gate is also tied in electrically with the press operation. A ram spacer is provided for reducing daylight opening. Die mounting holes in both the movable and stationary platens and the knock-out holes in the horizontal and vertical center units of the movable platen are in accordance with SPI standards.

Specifications for this Model S-20-350 machine are as follows:

Hopper capacity, lbs.	150
Max. ozs./shot, styrene	20
Plasticizing capacity, cylinder/hr./lbs.	210
Max. cycles/hr.	700–900
Shot capacity, cu. in./min.	1290
Speeds:	
Die closing, forward, in./min.	1070
Die closing, return, in./min.	935
Injection, forward, in./min.	169
Injection, return, in./min.	*
Diameter of hydraulic injection cylinder, in.	7 (2)
Stroke of injection plunger, in.	5
Injection pressure, psi	20,000
Max. hydraulic pressure, inj. ram, psi	2,000
Clamping capacity, tons	350
Clamping ram stroke, in.	24
Dia. of clamping cylinder, in.	17¼
Max. hyd. pressure on clamping ram, psi	3,000
Daylight opening, in.	32
Min. die thickness, in.	8
Max. die sizes, in.	20½ × 34½ 20½ × 35
Rated max. power consumption, heating units, kw.	32.3
Motor, total hp.	55
Oil reservoir capacity, gals.	200

Item 28

IF PHENOLICS CAN DO IT, PLENCO CAN PROVIDE IT—AND DOES—FOR PHOENIX METAL CAP CO.

PLENCO PHENOLICS
FOR BETTER PLASTIC PRODUCTS

TRAINED SEALS

PHOENIX MOLDED CAPS... MADE TOUGH, MADE TRIM, MADE TAINT-FREE WITH

PLENCO
PHENOLIC MOLDING COMPOUNDS

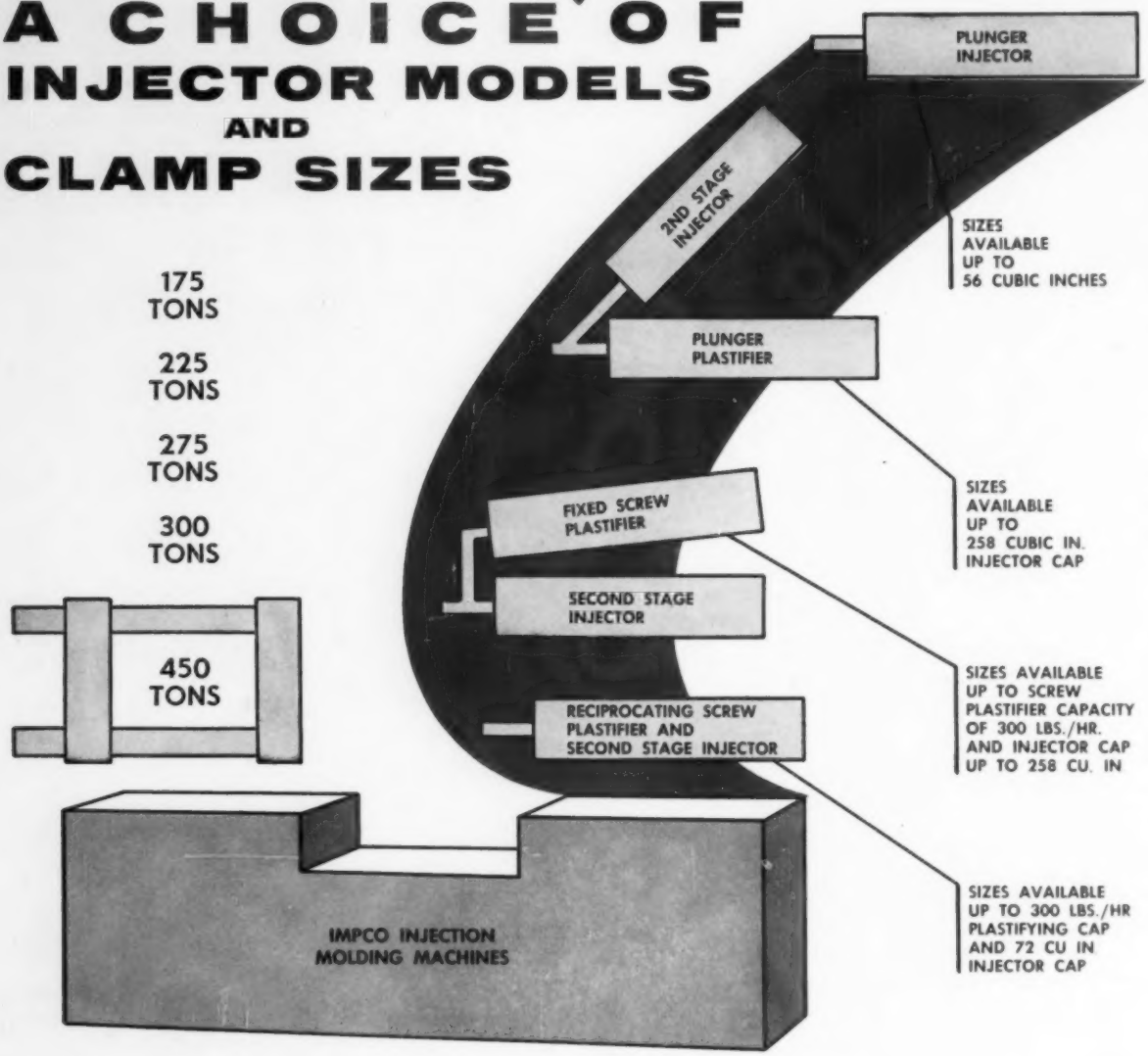
These phenolic plastic caps are great performers. Their job is to protect and extend the looks and life of the products they seal. They top containers of brands all America knows . . . leading names in drugs and cosmetics.

When molding with phenolics, Phoenix Metal Cap Co., Chicago, Ill., chooses *Plenco*. Plenco compounds have the surface, the strength, and minimum odor and bleed. They have the non-mold-staining characteristics required by Phoenix. They meet the needs of high speed, high quality molding so important in nearly every industry.

Plenco phenolic molding compounds are obtainable already-made or specially formulated, general- or special-purpose, for countless applications. You get them with experienced Plenco counsel. Simply call.

PLASTICS ENGINEERING COMPANY
Sheboygan, Wisconsin
Serving the plastics industry in the manufacture of high grade phenolic molding compound, industrial resins and coating resins.
For more information check Readers' Service Card No. 112

IMPCO *Flexibility* GIVES YOU A CHOICE OF INJECTOR MODELS AND CLAMP SIZES


175 TONS
225 TONS
275 TONS
300 TONS
450 TONS
PLUNGER INJECTOR
2ND STAGE INJECTOR
SIZES AVAILABLE UP TO 56 CUBIC INCHES
PLUNGER PLASTIFIER
FIXED SCREW PLASTIFIER
SECOND STAGE INJECTOR
SIZES AVAILABLE UP TO 258 CUBIC IN. INJECTOR CAP
RECIPROCATING SCREW PLASTIFIER AND SECOND STAGE INJECTOR
SIZES AVAILABLE UP TO SCREW PLASTIFIER CAPACITY OF 300 LBS./HR. AND INJECTOR CAP UP TO 258 CU. IN
IMPCO INJECTION MOLDING MACHINES
SIZES AVAILABLE UP TO 300 LBS./HR PLASTIFYING CAP AND 72 CU IN INJECTOR CAP

The flexibility of Impco design gives you the combination of injector and clamp which fits your operation! This means a custom built machine, designed and sized to suit your requirements.

In addition to standard single stage injection, we offer two-stage type injection in three options: Impco Second Stage Injector, Impco Fixed Screw Injector and Impco Reciprocating Screw Injector — all in a number of capacities.

Clamping sizes vary from 175 to 450 tons.

Let us show you more specifications of our complete injection machinery line designed for highest molding economies.

IMPCO®

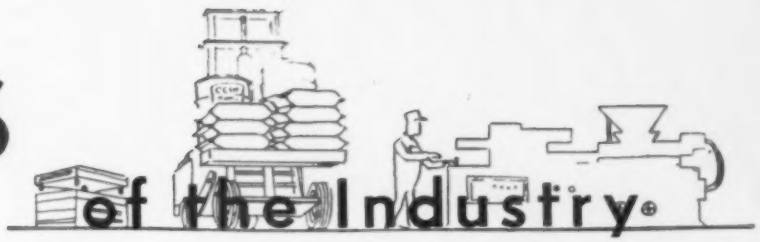
IMPROVED MACHINERY INC.

NASHUA, NEW HAMPSHIRE

IN CANADA: SHERBROOKE MACHINERIES LIMITED, SHERBROOKE, QUEBEC
IN EUROPE: SUNDS VERKSTADER AB, SUNDSBRUK, SWEDEN

For more information check Readers' Service Card No. 113

NEWS of the Industry



proprietary changes

Enjay Chemical Co., a Division of Humble Oil & Refining Co., and J. P. Stevens & Co., Inc., a prominent textile company, have purchased the operating assets and facilities of National Plastic Products Co., a manufacturer of synthetic fibers, and have formed a new jointly-owned company, which will continue the National Plastics name and its present management for the purpose of accelerating the commercial development of polypropylene and other new fibers. National Plastics manufacturing facilities are at Odenton, Md.

Catalin Corporation of America's board of directors have ratified the acquisition of Lebec Chemical Corp., Paramount, Calif., manufacturer of a variety of synthetic resins, in order to assume a competitive position on the West Coast. Lebec's president, John C. Plummer was elected a vice president and director of Catalin.

H. I. Thompson Fiber Glass Co. has been negotiating with Minnesota Mining and Manufacturing Co. for purchase of the facilities of 3M's Zenith plastics division at Gardena, Calif. 3M said the sale was intended to avoid competition with customers of its Reinforced Plastics Div., while HITCO stated the proposed acquisition of the 3M plant was part of a long-range growth plan to consolidate and expand HITCO's production facilities and markets for aerospace products.

Diamond Alkali Co. has acquired Fiber Chemical Corp., Cliffwood, N. J., organic chemicals and inorganic specialties producer, through an exchange of stock. Fiber Chemical will be operated as a wholly owned subsidiary of Diamond Alkali.

Harshaw Chemical Co. has sold and will transfer its vinyl stabilizer business to the Ferro Chemical Div. of Ferro Corp., Bedford, Ohio, effective October 1. The sale includes all formulations, production techniques, inventory, sales, technical service, development and research records.

Stearns Manufacturing Co., St. Cloud, Minn., manufacturer of plastic products for hunting, camping and marine equipment, will become associated with Plastics Corp. of America, Minneapolis, as an operating subsidiary, thus giving PCA its first division manufacturing plastics for the consumer market.

Star Supermarkets, Inc., has acquired Spaulding, Inc., Chicago, Ill., a manufacturer of plastic dinnerware. Star will maintain Spaulding's production of melamine dinnerware and also intends to establish a division for industrial molding.

new plants, labs & additions

Cast Optics Corp. has placed in production a completely automated plant in Hackensack, N. J. for the production of its Evr-Kleer cast acrylic sheet at the rate of 7,000,000 pounds yearly, in all sheet sizes and thicknesses, flat or corrugated, and in a complete range of colors.

Thermotech Industries, Inc., thermosetting and thermoplastic custom molders, has announced the opening of its third plant in St. Petersburg, Fla., in order to accommodate customers in the field of space vehicles and other government projects in that area.

Marshall W. Hanks, a Thermotech vice president and superintendent of its Booker & Wallestad division at St. Louis Park, Minn., has been named manager of the St. Petersburg plant, and Ralph J. McDonald has been promoted to production superintendent of the new plant.

Edison Technical Services, Inc., Metuchen, N. J., a plastics consulting and liaison firm, specializing in discovering, reporting, and analyzing plastics technology particularly in extrusion, for clients both in the United States and overseas, has been formed by Allan L. Griff.

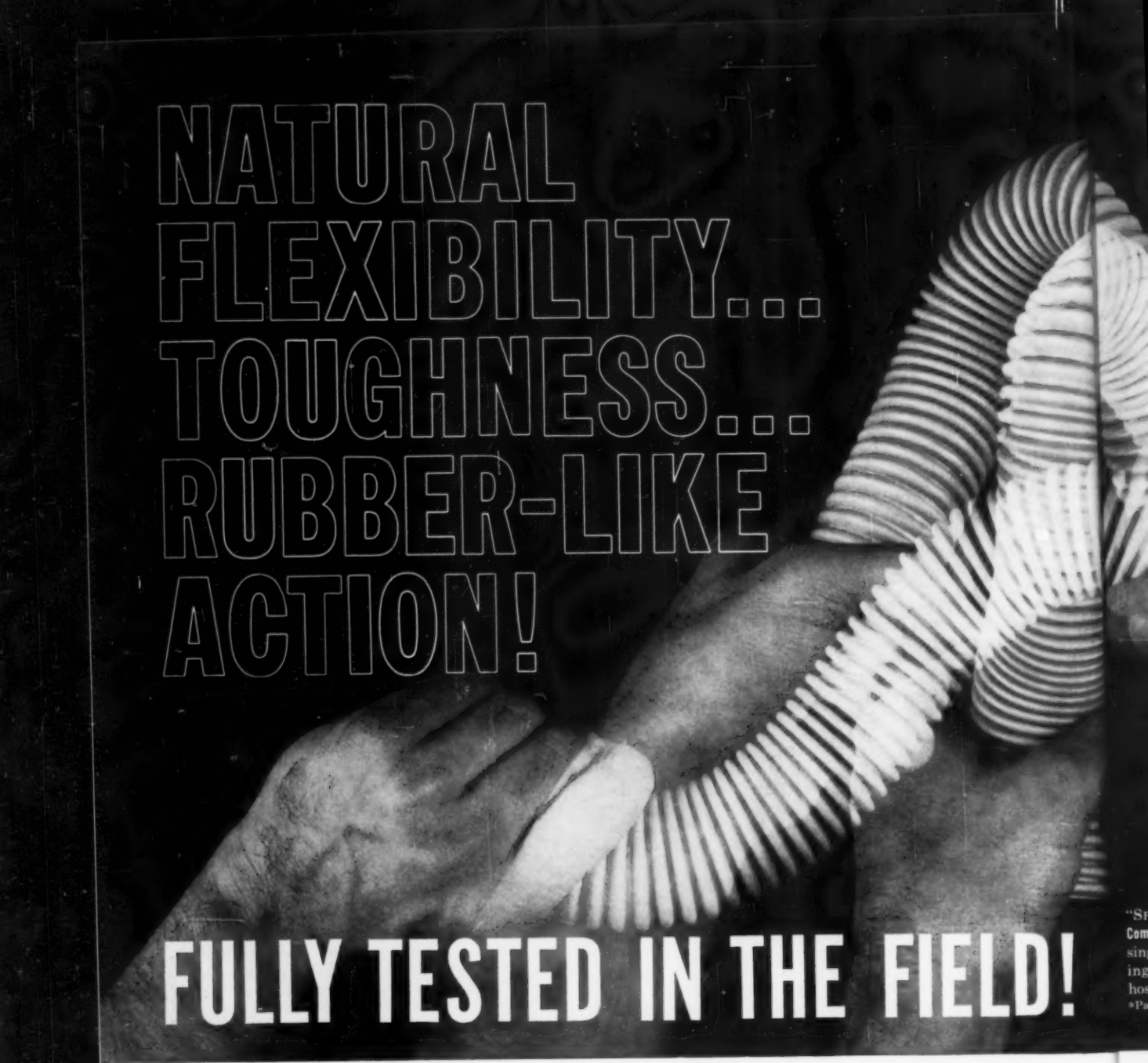
news from abroad

Dow Chemical Co. has established a new Plastics Technical Service location at Rotterdam, The Netherlands, and one at Plaquemine, La. Earl R. Smith will be resident customer service engineer in Rotterdam for one year as a member of the Dow International Section of PTS. L. W. Meyer will operate the PTS laboratory at Plaquemine, which will be a part of PTS South with headquarters in Freeport, Tex.

Monsanto Chemical Co. has established a European headquarters at Geneva, Switzerland, through its wholly owned subsidiary Monsanto Overseas S.A. (MOSA), in order to strengthen its sales, technical and investment position in Western Europe. W. M. Russell, MOSA president, will be in charge of Geneva operations. Also located at Geneva will be W. R. Haas, regional director of sales; Dr. C. H. Davenport, European technical representative; and D. B. Hirsch, manager of economic planning for Europe.

Cabot Corp. has entered into an agreement with Fabriques de Produits Chimiques de Thann et de Mulhouse (F. P. C.) under which Cabot will enjoy exclusive rights in the United States to F. P. C. patents and know-how on the production of pigment grade titanium oxide by the flame chloride process.

NATURAL FLEXIBILITY... TOUGHNESS... RUBBER-LIKE ACTION!



FULLY TESTED IN THE FIELD!

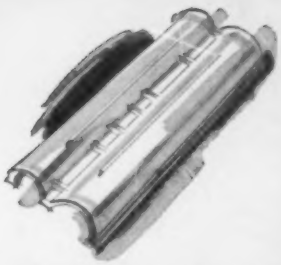
BAKELITE DPD-6169 Ethylene Copolymer gives you all 3...without a plasticizer! Easy to fabricate! Good stress-cracking resistance and low temperature properties, too!

Touch it! DPD-6169 has a rubbery "feel" and texture.

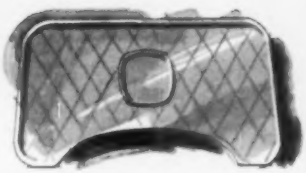
Bend it! In flex-cracking tests, using Ross Rubber Test Apparatus, DPD-6169 survived more than 2,000,000 cycles at room temperature. Other flexible plastics fail anywhere from 10,000 to 135,000 cycles.

"SPIRALOCK"* hose, developed by **Plastiflex Company**, Venice, Calif., is made from a single material, yet requires no reinforcing wire. Advanced methods produce hose for consumer and industrial use.
*Patent applied for.

PACKAGING: Excellent flex life makes DPD-6169 ideal for unusual squeeze and bellows-type dispensers, spray bottles for insecticide, etc.



AUTOMOTIVE: No plasticizer "fogging" because there's no plasticizer!



HOUSEWARES: A likely successor to rubber because of its excellent aging resistance, flexibility, easy colorability. Ideal for mats and trays.

FURNITURE: No lacquer marring due to plasticizer migration. Higher coefficient of friction makes it ideal for non-slipping caster cups.

TOYS: (right) When toys must withstand severe punishment, DPD-6169's extreme flexibility and flex-cracking resistance pay off. Competitive in price, too.

APPLIANCES: (left) Its low-temperature properties and excellent stress-cracking resistance make it ideal for refrigerator gaskets and washing machine tubing, respectively.

Excellent low-temperature performance—Maintains flexibility at temperatures colder than −105°C. Materials which require added plasticizers simply cannot do this.

Natural flexibility! DPD-6169 comes by its high flexibility naturally—no plasticizer is needed. That means freedom from embrittlement, and other problems due to migration.

Fully field-tested! BAKELITE DPD-6169 is receiving an enthusiastic welcome from hundreds of fabricators. Many of them already consider DPD-6169 a major contribution to the plastics industry.

Competitively priced! DPD-6169's low pound volume cost makes it competitive with other materials!

Easy to mold and extrude—Field trials and production experience have proved out the excellent flow characteristics and processing latitude of DPD-6169.

For complete information on BAKELITE DPD-6169 Ethylene Copolymer, write Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. *In Canada:* Union Carbide Canada Limited, Toronto 12.

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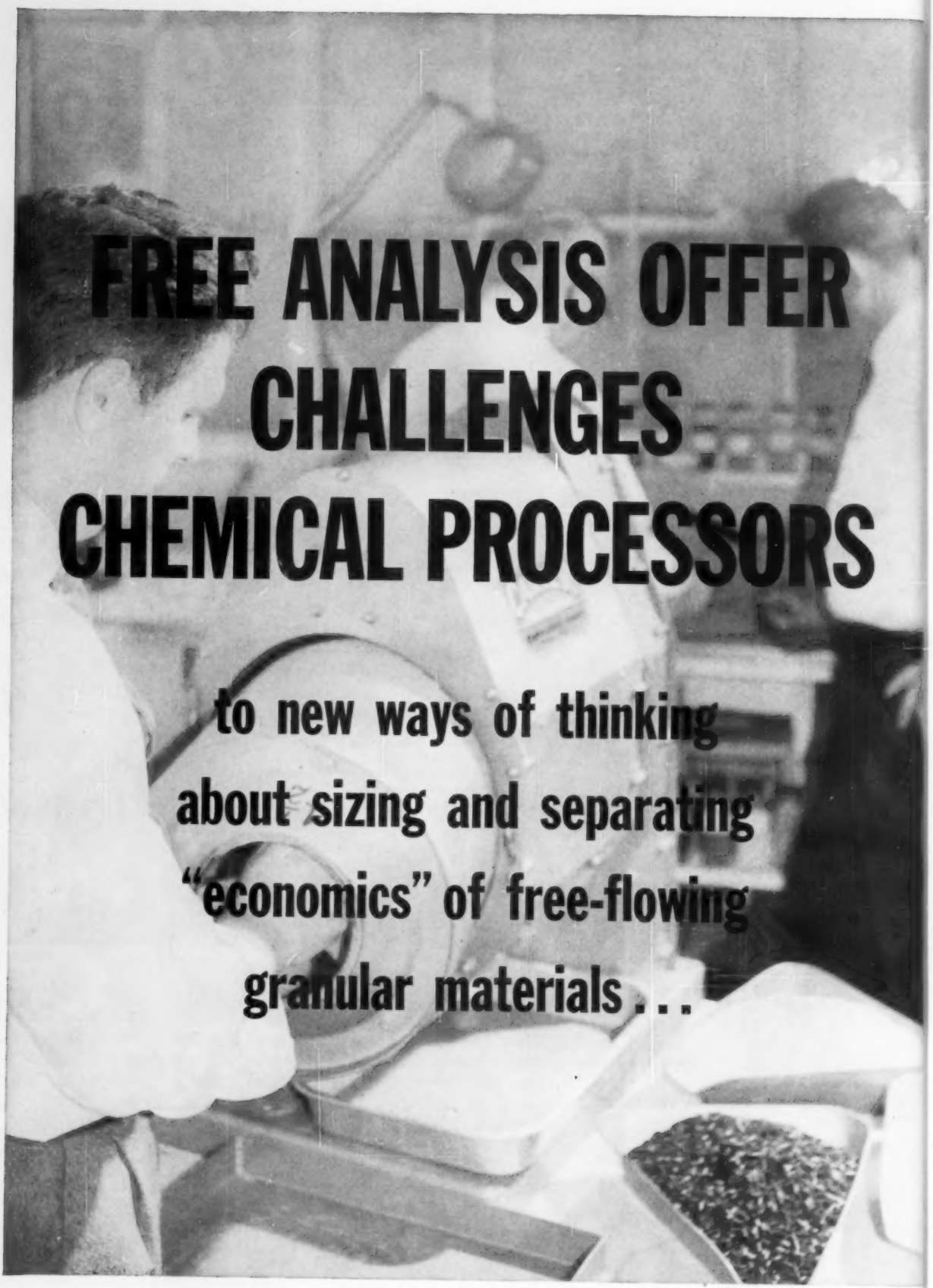
UNION CARBIDE **PLASTICS**

For more information check Readers' Service Card No. 114


FREE ANALYSIS OFFER
CHALLENGES
CHEMICAL PROCESSORS
to new ways of thinking
about sizing and separating
"economics" of free-flowing
granular materials . . .

SIMON-CARTER laboratory analysis shows how new rotary principle of separation provides profitable answers for processors!

This is your invitation to begin to enjoy the many advantages of a remarkable processing revolution that is under way in today's chemical industry. Radically different new sizing, separating techniques, made possible by the *rotary-motion* design of Simon-Carter machines, are revising cost figures throughout the industry. New S C machines daily are delivering vastly increased production and efficiency—greater volume, accuracy and compactness, less maintenance—for today's processors.

This small hand-driven Disc Separator model enables Simon-Carter technicans to duplicate length separations in miniature with only a small material sample supplied by the processor.

Your key to these benefits: a remarkable free offer now being made to the chemical industry by Simon-Carter. It is this: Our expert technicians and completely equipped laboratory will undertake a complete analysis of your sizing and separating problems! This is a *free* service and our detailed recommendations impose no obligations. We will analyze separations by width, thickness, length, all types of sizing requirements; rough, fine, mechanical or by air, pneumatic conveying possibilities, dewatering—much more! Our entire laboratory is at your disposal!

Every month finds more compact, *rotary* Simon-Carter machines turning out impressive production records in the chemical industry. But we make our unique offer because we want *all* processors to know what significant "economies" *rotary* action can produce!

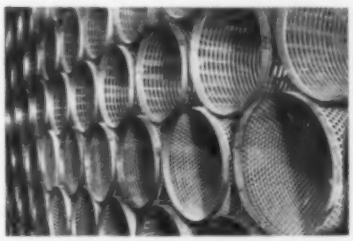
Do you have a problem removing agglomerates? Analysis may show

The material to be separated or sized is carefully examined under magnification to better fit tests and equipment to the problem.

that the Simon-Carter Scalperator can solve it. The *rotary* action of its scalping reel can handle up to 30,000 lbs. per hour. The Simon-Carter Laboratory can test your material samples on many different reel perforations and 5 different capacity models to match your needs!

Or do you have a length separating problem? Simon-Carter technicians use test equipment that duplicates the *rotary* motion of the Simon-Carter Disc Separator. Rotating discs, each with thousands of precisely formed tiny pockets, select or reject materials by length with uncanny accuracy! We will experiment with different disc pocket sizes, operating speeds, output volumes, etc., to exactly fit your requirements!

Another important series of tests involve *width* and *thickness* sizing. The Simon-Carter Precision Grader does these jobs. We can duplicate its action on test equipment—experiment with up to 80 different cylinder perforations for you! There are many other tests and many other Simon-Carter machines like the Duo Aspirator, Sonic Conveying System and Spin-Away Centrifugal Dryer, that can be applied to solve your particular problems.



These are some of 80 different cylinders, each with different size perforations, that Simon-Carter can choose from to solve your width or thickness separating problems.

In addition to laboratory tests, Simon-Carter engineers will recommend ways to streamline *all* your separating and sizing functions—improve not just one processing step but the whole system! Through Simon-Carter's *free* analysis offer you can take a long stride forward in efficiency! Send in the coupon below for details today!

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Please send me more information on the Simon-Carter free analysis offer. I am interested in its application to our separating and sizing procedures. I understand that the free analysis offered by Simon-Carter imposes no obligation on myself or my firm.

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PLASTICS
THE MAGAZINE OF APPLIED ENGINEERING
TECHNOLOGY

Designing With Plastics

Plastics are available with a bewildering array of properties. Here is a plan for evaluating them, selecting them and engineering them.

by R. L. Thorkildsen and J. V. Schmitz

The modern design engineer has a wide variety of versatile new materials at his disposal: among the most useful and challenging of these are the organic plastic polymers.[1] Like other new materials, plastics offer great design opportunities, and also present special design problems.

Plastics differ considerably from other common materials in their mechanical behavior, and many mistakes in design and application have been made. If we are to exploit this new family of materials properly we shall have to learn new concepts of design. This is a big but not an impossible task, for plastics conform to physical laws that we can discover, describe and use.

PATTERN OF ORIENTATION ANISOTROPY in an injection molded polystyrene part is shown in polarized light photograph.

Property advantages of plastics

The chief advantage of plastics, and derivation of the name *plastic*, is in processing. Plastics can be readily formed into films, fibers, foams, reinforced laminates, and complicated molded[2, 3] or extruded configurations. Plastics offer definite cost advantages: processing is often fast and mechanized, and costs for tools, equipment, and overhead are low. Trends in the prices of raw materials promise further economy, for while raw plastics are getting cheaper, most other materials are growing more expensive.

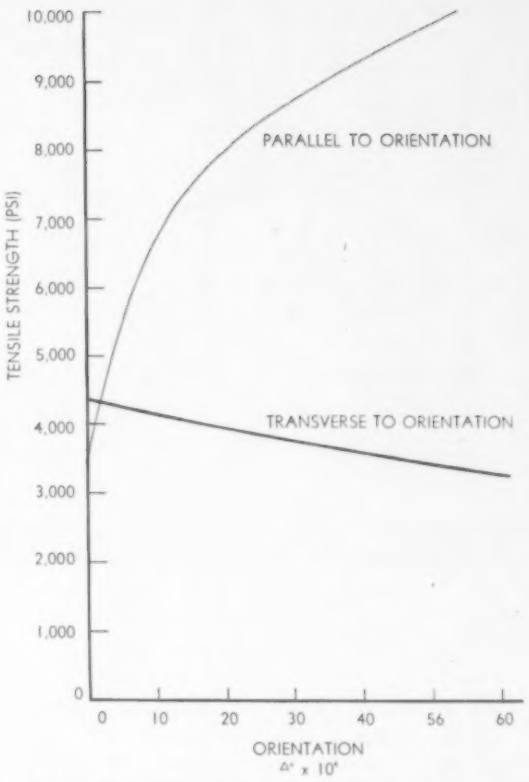
Plastics are adaptable to a gamut of design needs. There are over 30 general classes of plastic materials, e.g., phenolics, nylon and polystyrenes. Within these classes are thousands of individual chemical compositions with a very broad range of useful properties. Most plastics are low in their electrical conductivity, thermal conductivity, and specific gravity. Color, transparency and appearance are particularly important advantages of some classes, such as the acrylics, cellulosics, or urea-formaldehydes. Some, like nylons and fluorinated plastics are available with a low coefficient of friction, others, among them some vinyls and elastomers, have non-slippery surfaces. Various plastic materials, such as polyolefins, resist water and many chemicals; others are unusually tough and resilient. This wide variety of plastics, each with its own unique advantages, offers a multitude of design opportunities. On the other hand, the very breadth of selection burdens the design engineer: he has to find the material that gives him the best combination of properties for his design.

Property limitations of plastics

Like any material, plastics have mechanical, thermal and chemical limitations: good design and careful choice

of material can overcome them but they must be clearly recognized. The generally low strengths of many plastics is sometimes a problem; higher-strength plastics are available, but usually at the expense of processing ease, toughness, or cost. Combining plastics with metals offers an alternative way of getting needed strength, just as iron rods in reinforced concrete. Some applications require plastics with improved low- and high-temperature resistance and low flammability, and these are becoming available. Problems involving scratch resistance, color stability, or thermal coefficient of expansion can often be solved by good design.

Plastic materials are basically organic polymer molecules held together by relatively weak forces, a fact that emerges when temperature, a too high rate of load application, or chemical environment alters their mechanical properties. Gasoline attacks polystyrene as vigorously as acids attack steel; oxidation embrittles nylon just as it does iron or brass. In general, plastics are more resistant to water systems than are metals, but they are more sensitive to organic solvents. The fluorocarbons, however, are remarkably resistant to almost all chemicals. Processing effects are familiar problems in work with any material. Plastic molding can influence those properties that are functions of slow orientation, differential shrinkage, and thermal stresses. Striking examples of anisotropy[4]—the manifesting by a material of different properties when tested along axes in different directions—of molded plastic parts may be seen in the illustration on these two pages.



ORIENTATION ANISOTROPY produces extreme effects on the 73°F. impact strength of injection molded polystyrene specimens.

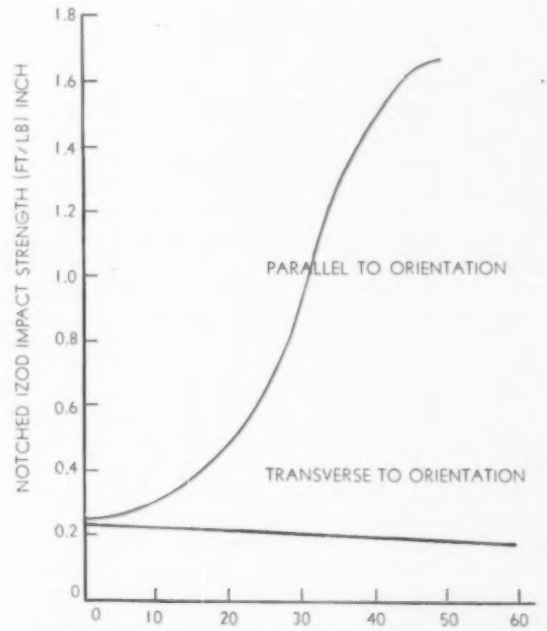
Time and temperature effects

The profound influences of temperature and of time —the rate or duration of load applications—on the properties of plastics are more difficult to appreciate.

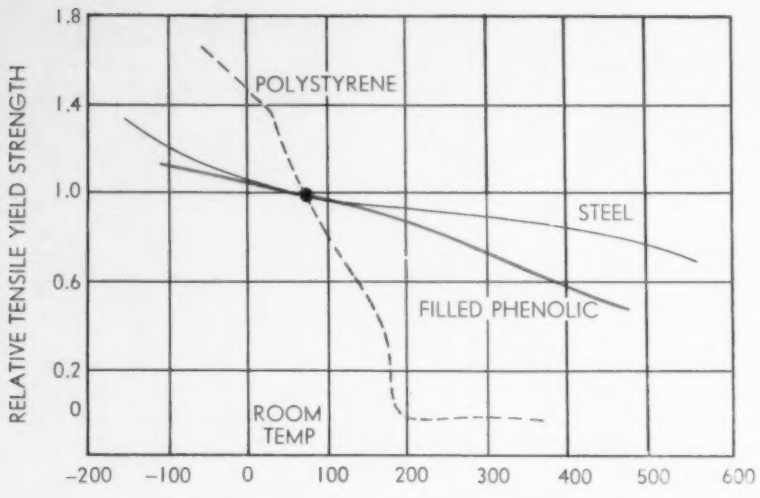
The useful temperature ranges of plastics differ among various classes but generally within narrower limits than metals. The present service temperature ceiling for plastic materials is around 600°F. Many plastics have much smaller useful temperature ranges: from —20° to 180°F. Even within this range, the strength properties of the material can change greatly. [*See illustration on page 28.*]

The rate or duration of load application affects the strength of all plastic materials. This time-dependency is a direct result of movement of the loosely-held organic high polymers in all plastics. Like chemical resistance, time-dependency varies widely among plastics, but no plastic, in its load-bearing strength, completely follows Hooke's Law. Creep occurs under constant load; stress relaxation occurs under constant strain. Catastrophic failure can occur at low loadings because of fatigue (alternating stress), creep (steady stress), or shock-loading (impact). [*See illustration on page 28.*]

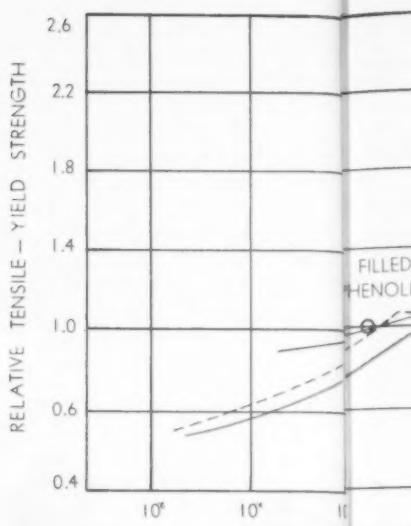
Time-dependent strength also shows marked interactions with temperature or with chemical environments. A material that is good at one temperature might be poor at another. The fatigue strength of some plastic materials, for example, can decrease, contrary to intuition, when temperature is reduced. Chemical environment also can considerably reduce time-dependent strength.[5] [*See illustration on page 29.*]



TENSILE STRENGTH of injection molded polystyrene part is greatly increased in the direction parallel to plane of orientation.



TEMPERATURE INFLUENCES relative tensile-yield strength (% of strength at 73°F.) of thermoplastic polystyrene much more than thermosetting phenolic or mild steel.



TIME-DEPENDENCY, varying tensile strain rates, af differently than filled phenolic resin. Effect o ild ste

General concepts of evaluating plastic designs

Before choosing a design and material, the engineer should be clear about his reasons for considering plastics. He should set down, as completely as possible the conditions under which the part will operate in service, covering such points as temperature extremes and chemical environments, including not only the obvious chemical, weather, or solvent exposures, but also such factors as contact with human perspiration or other chemically-active agents like paints, rubbers, or other plastics. He should understand possible stress levels and modes, and establish how long the part must last. The latter is a direct function of the kinds of stresses and times involved in assembly, shipping, and use. The functional importance and value of the part is also a basic consideration, for it will determine the time and effort that he should spend in proving his design.

The best way to screen a material or a design is to expose it to the actual conditions of use. Except in such applications as packaging or film, this procedure is too expensive because most applications involve expensive molds or complete assemblies, or require too much time to test under conditions of use. A less reliable though more practicable means of evaluation is the accelerated testing of complete assemblies. Increasing the frequency of operation may in many cases yield valid results. A slight increase of temperature is frequently satisfactory, but great increases are not; nor are big increases of stress levels. Accelerated engineering test methods should, if possible, be correlated with parallel end-use tests.

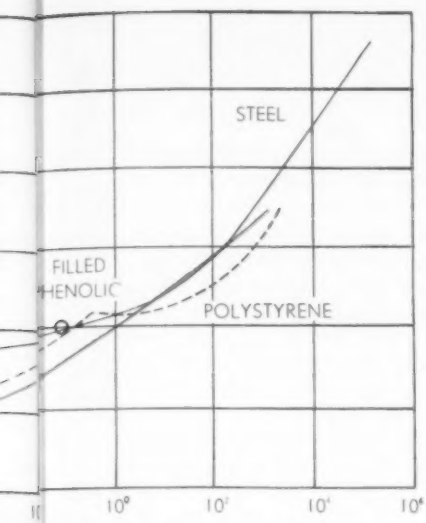
A third kind of evaluation, the testing of prototype samples, is usually still less reliable than the other testing methods, though it does allow more tests to be run at an even lower cost.

Except in the most simple and undemanding cases, intuition and engineering tests alone are rarely adequate guides to choosing plastic materials. Most often at least a preliminary screening is needed to limit the choice of material and process to a workable number of possibilities. Preliminary screening data are available from a wide variety of fairly simple and relatively inexpensive laboratory tests. Laboratory evaluation tests, many of which have been developed by the American Society for Testing Materials,[6] make possible testing of a large number of materials under many combinations of conditions.

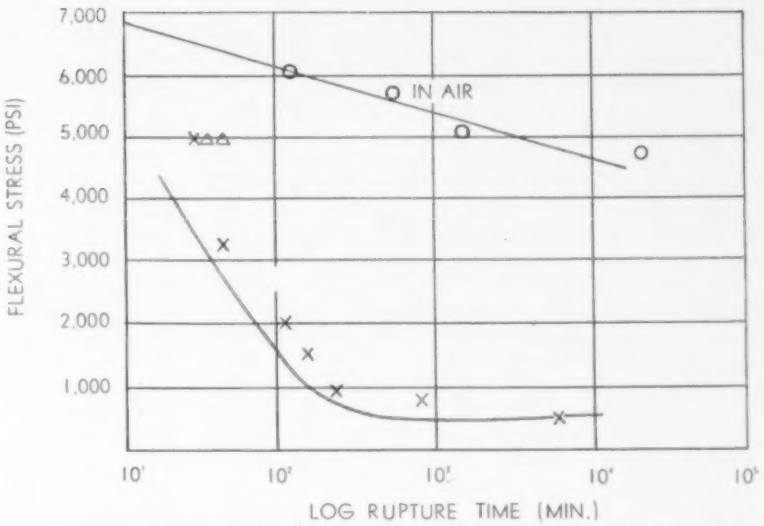
Some property data are available from raw materials suppliers. Chemical companies that produce plastic materials are generally interested in seeing that their materials are properly used. The best companies provide good facilities in technical service laboratories for answering customers' questions. But even the best supplier laboratories are limited in what they can do for you. They are handicapped by a generally poor understanding of your end-use requirements. And since they deal with a great many customers in widely different fields, they rely heavily on conventional all-purpose tests. These may mean a great deal in your application or very little. Vendor data can be used as a general guide on chemical resistance, temperature resistance, strength, and toughness properties. They will seldom, however, give much information on processing or time-dependent effects. Nor can the supplier of one material be expected to give a balanced and realistic comparison of his material with his competitors'. In the final analysis it is you, not your material supplier, who has the responsibility for the final design.

Group coordination

Few cases admit of reliable designing solely on the basis of information furnished by material suppliers, even



strain rates, affects high-impact polystyrene
ct of mild steel is included for comparison.



FLEXURAL CREEP RUPTURE of high-impact polystyrene in air at 73°F. is little affected by stress: when in contact with vegetable oil, under stress, values decline significantly.

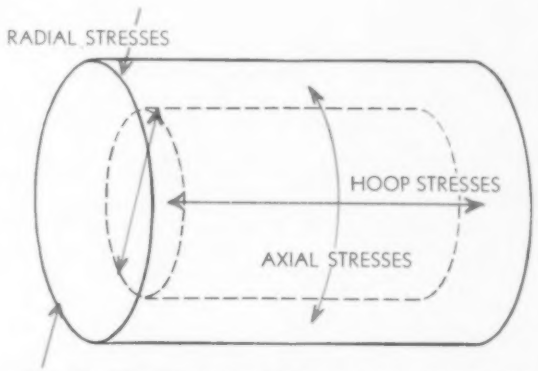
when supplemented by engineering tests. Among the few are the very simple designs where failure is unlikely or inexpensive. For most plastics applications, greater care is required.

Experience has taught us a better approach for safe designing with plastics—coordinated effort by a plastics application team. The team usually consists of a design engineer, manufacturing engineer, materials engineer and laboratory evaluation specialist. Such a team, augmented when needed with raw material suppliers, mold designers, and molders, can cover the full range of problems from generating initial design ideas and choosing materials through evaluation and process development to final production and quality control. In the course of this program the team establishes realistic specifications and test methods for material, process, and finished part.

The makeup of the team is crucial to its success. The design engineer establishes performance specifications, reduces technical conclusions to a practical design, and judges final over-all performance. The materials engineer, who may be a polymer chemist, a physicist, or a mechanical engineer, is equipped to examine the performance requirements of materials against a background which includes knowledge of all available materials. He can limit the selection of possible materials to a manageable number without eliminating good possibilities. The laboratory-evaluation specialist, working with the materials engineer, can determine the tests to be used to screen materials and can set up long-term tests for critical properties. The laboratory specialist can also consider evaluation and specification tests on the basis of polymer chemistry. After preliminary designs have been established, the laboratory specialist can help set up accelerated engineering tests based on sound principles of polymer chemistry and physics. He can help relate laboratory, engineering, and end-use tests on the basis of experience. The manufacturing engineer is able to anticipate possible manufacturing problems, and conduct process development work.

Staffing a plastics application team can present problems. Individuals who are responsible for recognizing conditions of the intended application that may seriously affect the material used do not always have the necessary technical background to do so. In the plastics industry, engineers of widely differing disciplines and backgrounds must be used: organic chemists, physical chemists, chemist and mechanical engineers, and so on—all have a vital place in the coordinated effort. Trouble arises when an electrical engineer is made responsible for chemical problems, or when a chemist must solve mechanical problems.

Large companies, like General Electric, support central services research and engineering laboratories. The



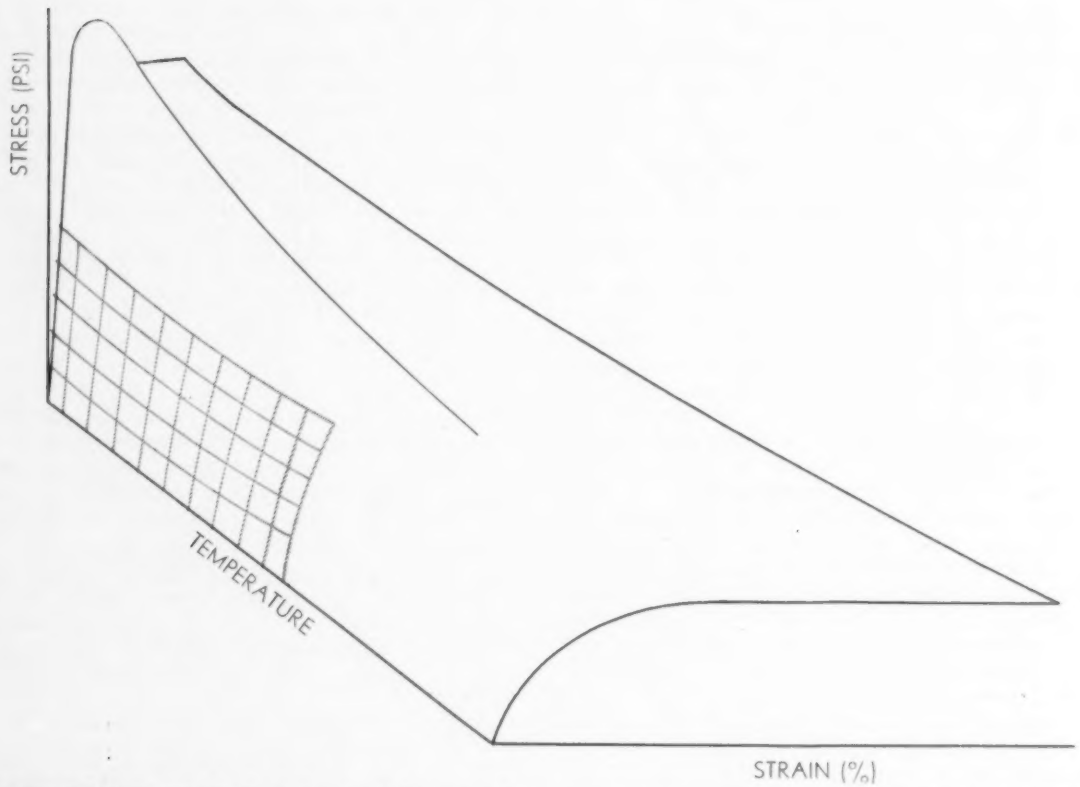
MISMATCHED THERMAL STRESSES are depicted. The direction of stresses on resin, which encapsulates a metal core (dotted line) are indicated by colored arrows: the resin is stretched in axial and hoop directions, compressed in vertical direction.

plastics application team maintains close contact with these laboratories for basic scientific information. Practical problems, properly defined and interpreted, furnish those scientific questions that must be answered in long-range work.

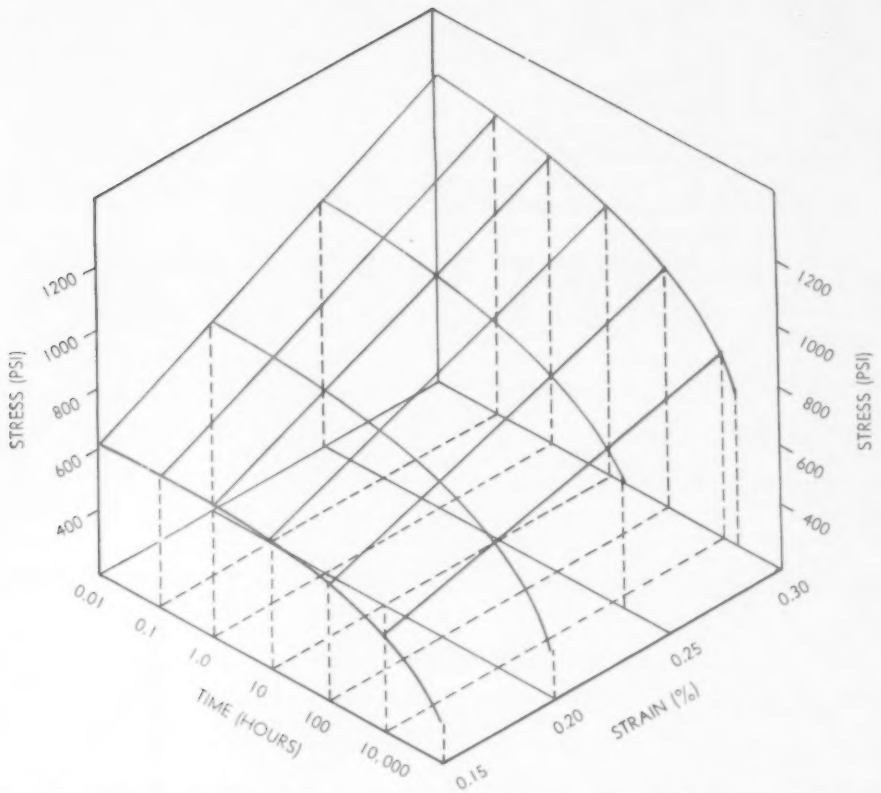
The plastics application team should regularly consult material suppliers for specific data on their materials, information on new developments, and technical background for evaluation and processing. We have found that we are able to use information from material suppliers more efficiently when we have our own parallel laboratory program. For major projects, contact with the material suppliers should be broadened to include his technical service, development, and research people.

A recent design program for refrigerator-door liners, offers an example of the plastics applications team at work.[7] Vacuum-formed plastic door liners improve the performance and usefulness of refrigerators while affording production economies. Design engineers have become confident in this application and have increasingly relied upon the door liner to stiffen the whole door assembly. As in all applications, hazards can be encountered in assembly, shipping, and during use. Temperature exposure is limited to the −20 to 150° F. range, chemical exposures include water solutions, natural food oils and juices, and other common kitchen hazards. Stress levels are generally kept low, but loads can be long lived, as long as 20 years. Extreme shock loads can occur during shipment. Abuse from users impose peak stress loads. Repeated door slamming or thermal cycling can cause fatigue failure.

In order to evaluate the designs and materials for door liners, we had first to translate the conditions of use into terms of stress, time, and temperature.[8] [*See illustrations on these two pages.*] When the important limits had been established, we had to design evaluation experiments to screen materials. We then compared our laboratory findings with the results of engineering tests on actual door assemblies, complete with door liners, made from the most promising materials. Vacuum-forming produces distinct anisotropy a phenomenon which is best evaluated in a realistically fabricated part. Some useful engineering tests on inner doors stimulate customer abuse: they include repeated door racking under high stress, low-temperature impact tests,[9] and repeated door slam. We completed the evaluation program by correlating the laboratory and engineering tests with actual field experience. This approach to plastics design resulted in meaningful specifications for design and material, and in quality-control tests that will help assure continuing satisfactory performance. Similar approaches have been used in the design of a glass-rein-



STRESS-STRAIN-TEMPERATURE relations for high-impact polystyrene are plotted in this three-dimensional graph. The specimens were tested at a 0.10 in./in./min. strain rate. The preferred design area is indicated in color on the left.



STRESS-STRAIN-TIME relations for high-impact polystyrene are detailed in another three-dimensional graph. The data provides the necessary information for the design of refrigerator door liners to meet conditions expected in actual service.

forced automobile body[10], shoe heels[11], the "all plastic" house, military missiles, electrical apparatus, aircraft sandwich structures[12] and plastic boats[13].

Materials and structure analysis

Although we have already discovered some rules for working with plastics, and are learning more with each new application, there is yet much we do not know about how plastics behave in actual use. Mature design practice requires, for example, that we know precisely how to account for creep. Serious interest in the quantitative description of creep began about 1910[14] and since then has developed along three major paths: Curve-fitting techniques, mechanical equations of state; and theories of linear viscoelasticity. The design engineer should not choose any of the three simply because it is theoretically valid. His choice should be based upon how well the law describes the material test data, and how readily it can be applied to analyzing the stresses and strains of a specific structure. Laws that show considerable promise in describing data very often turn out to be rather unmanageable in stress analysis, a difficulty that can be remedied by better mathematical techniques, which includes approximate methods of structural analysis.

Thermal fatigue presents a similar problem. It is often encountered when plastics are used in conjunction with metal. The illustration on page 29 presents a typical case: it shows an electrode, or transformer potted in a plastic resin. Suppose the component is cycled in temperatures from 120 to -40°F. The large difference between thermal-expansion coefficients of the plastic and the metal causes a strain mismatch between the core and encapsulant. This fatigue cycle can be defined by the following conditions: a strain cycle is imposed, the temperature of the material changes, the cycle frequency is low, the wave form of the cycle may be very irregular. Most commonly available fatigue data do not describe these circumstances but rather are taken by imposing a stress cycle at a constant and uniform specimen temperature at a high-frequency (1,800 cps.). The differing effects of the actual and the test conditions produce different kinds of fatigue. Thus, the design engineer cannot rely upon the commonly available data; he must in all cases use test data taken either under conditions of use, or under conditions that correlate with the conditions of use. There can be no exceptions to this rule if the data are to be meaningful.

Almost all standard materials tests are made with the idea of examining only one distinct type of behavior at a time. The effects of stress concentrations, for example, are studied separately from the effects of fatigue. The effects of superimposed stress concentrations and fatigue are seldom considered. They should be.

Most standard materials tests, moreover, are performed under uniaxial stress conditions—a tension test, for example. But the material in use is usually subjected to simultaneous stresses in more than one direction. If the core of the component illustrated on page 32 expands, the encapsulating resin would stretch in the axial and hoop directions, and be compressed in the radial direction. Such combined states of stress cause materials to behave very differently than they do in a simple tensile test. When for example, the effective rupture strength is reduced, the material becomes less ductile. At present, our ability to correlate complex stress-behavior with uniaxial behavior is not all that it should be. Indeed, it is common to find that engineers completely overlook the fact that combined stresses even exist in a given application.

Nor is there a convenient source for this information. Methods for computing stresses and deflections in the walls of an elastic pressure vessel are in everyday use in our engineering section, but an engineer would be hard pressed to find a handbook with a formula for computing the creep deformation of the same geometry. Mathematical techniques that account for creep, anisotropy and other somewhat unfamiliar properties of plastics are not at present available.

Thus, while plastics offer vast possibilities to the design engineer, they present also the problems that any new material presents. The solutions to those problems require that we find convenient quantitative relationships that can be used to relate the behavior of a material in a simple, preferably accelerated, laboratory test to the way the same material behaves in actual use; and further, that we describe the way the structures made of this material behave. In this way along can we develop methods that, while using a limited number of simple tests and mathematical tools, can enable us to predict material and structural performance. This is materials- and structural-analysis which, when accompanied by creative thought, can go far toward assuring a successful design.

BASIC THERMOMECHANICAL BEHAVIOR OF PLASTIC MATERIALS, including pure materials (methylcrylate) filled materials, (mica flakes, silica), laminated materials (canvas), reinforced materials (glass cloth), sandwiched materials (foams, honeycombs), etc.

Uniaxial Stress Behavior

Representation and extrapolation of:
Isothermal creep data.
Isothermal mechanical stress fatigue data.
Isothermal mechanical strain fatigue data.
Thermal fatigue data.
Cumulative fatigue damage data (both mechanical and thermal).
Effects of temperature and rate-of-loading on strength (short-time, creep, and fatigue) ductility and stiffness.
Effects of stress-concentrations on strength as a function of ductility.
Effects of cycle frequency and wave shape on fatigue.
Effects of mean stress or strain on fatigue.
Effects of rest periods on fatigue.
Effects of repeated loading and unloading on creep.
Effects of transition from glassy to rubbery state on all modes of behavior.

Combined-Stress Behavior

Effects of combined stresses on:
Ductility
Short-time fracture
Creep fracture
Fatigue fracture
Creep (stress-strain-time laws).
All the foregoing as a function of temperature and rate-of-loading, where applicable.

Superimposed Behavior

Effects on bulk behavior of superimposed:
Creep and fatigue (dynamic creep).
Creep and stress concentrations.
Fatigue and stress concentrations.
Chemical and mechanical environments.

ANALYSIS OF PLASTIC STRUCTURES

Effects of:
Creep, anistropy, large deflections and combined stresses on the behavior of plastic structures including common engineering geometries: beams, plates, shells, etc.

TOPICS IN PLASTICS BEHAVIOR and structural analysis about which little is known are listed. Designers could use the list in rating materials for thermo-mechanical applications.

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DOW PLASTICS TECHNICAL FILE

THERMAL INSULATING EFFECTIVENESS OF PLASTICS

The effectiveness of a plastics material as thermal insulation is measured by its thermal conductivity. A low "K" factor (thermal conductivity) indicates superior insulating ability. It is of prime importance when evaluating plastics, particularly foams. The following relationship applies when a fixed temperature differential exists across a material:

$$q = K A \frac{\Delta T}{x}$$

where: q = heat flow rate, BTU/hr.
K = coefficient of thermal conductivity, BTU-in./hr.-°F.-ft.²
A = heat transfer area, ft.²
ΔT = temperature drop, °F.
x = thickness, in.

A number of variables may affect the thermal conductivity of a plastic, such as density, moisture content, cell size (if foamed), etc. In addition, the important environmental factors of exposure temperature and time must be considered.

A comprehensive study requires many measurements at various conditions over a period of time. The classical techniques are unnecessarily complicated and time-consuming for the development of new materials. Consequently, Dow has developed a low cost, high speed thermal conductivity test apparatus for the purpose.

Based on the heat flow meter principle, a plastic may be tested in from 15 minutes to an hour, depending on density of the material under test. A 60° F. temperature differential is developed across a one-inch-thick specimen by maintaining hot and cold plates at the required temperatures. A calibrated heat flow meter, or thermopile, is placed in series with the specimen to measure heat transferred from the hot to the cold plate. The quantity of heat transferred varies depending on the insulating properties of the specimen.

Figure II shows the effect of density on thermal conductivity of molded polystyrene bead foam. An optimum low conductivity is reached at density levels of from 2 to 6 pounds. Higher or lower densities produce higher thermal conductivity.

Figure III shows the effect of cell size on thermal conductivity of extruded polystyrene foam. The heat transfer due to thermal radiation and convection is found to decrease with smaller cell size.

Urethane foams employing fluorocarbon blowing agents show an increase in thermal conductivity when aged at 140° F. This occurs because of the gradual inward diffusion of air which has a higher conductivity than does the blowing agent. Determination of equilibrium conductivity makes possible the design of an insulated structure which will perform satisfactorily over the expected life span of the structure.

Various average temperatures are encountered in different types of applications. It is necessary to design with a conductivity value determined at the working temperature level. Polystyrene foam has been found to have a nearly linear decrease in conductivity with decreasing temperatures. On the other hand, urethane foam decreases in conductivity until the fluorocarbon blowing agent begins to condense, then rises until only air remains in the cells. The conductivity then decreases again in the manner of a regular air-filled foam.

Data obtained in these continuing studies by Dow Plastics Technical Service Engineers of the thermal conductivity behavior of plastics are of value to designers and engineers in selecting plastics materials for specific applications. Full information and data obtained from these studies are available on request. Write THE DOW CHEMICAL COMPANY, Plastics Sales Department 1736DT12, Midland, Mich.

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Styron® • Polyethylene
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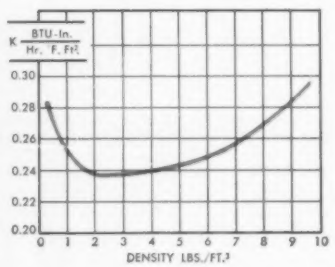
Tyril® • Saran

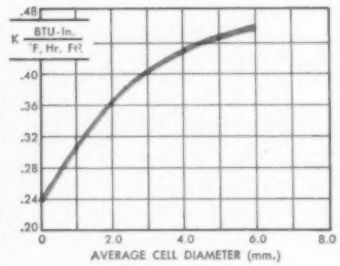
I THERMAL CONDUCTIVITY OF VARIOUS MATERIALS

MATERIAL	"K", BTU—in./hr. °F. ft.² @ 70°F.
Aluminum	1400
Steel	300
Concrete	12
Glass	4.0
Polyethylene (solid)	2.3
Polyethylene (loose granules)	1.0
Polyethylene (foam)	0.35
Polystyrene (solid)	1.0
Polystyrene (loose granules)	0.60
Polystyrene (foam)	0.24
Urethane (foam) fresh	0.12
Urethane (foam) aged	0.16-0.17

II THERMAL CONDUCTIVITY vs DENSITY FOR FOAMED POLYSTYRENE



III CELL SIZE vs "K" FOR FOAMED POLYSTYRENE
DENSITY 1.6 LB./FT.³



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Infrared Optics of CTFE

Quartz, special glasses and common salt are generally used for infrared optical components. But within limits polychlorotrifluoroethylene works as well and is cheaper.

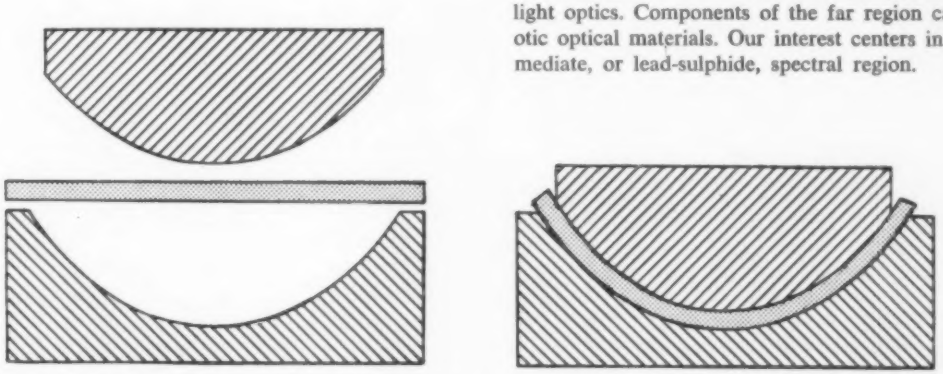
by James R. Jenness, Jr.

Infrared technology has advanced rapidly in the past decade, and with its advance the search for more economical manufacturing techniques has become more urgent. One area in which economies would be most telling is the optics, which now require special glasses and expensive grinding and polishing operations.

The requirements of infrared optical systems are by and large extremely demanding. In one application—windows—the requirements are less stringent and here substitute materials may conceivably be used.

Windows for infrared devices must, of course, be transparent to infrared radiation. They must, moreover, conform to the sensitivity of the detector used with the optical system. The wavelength characteristic of the detector thus offers a convenient way of describing transparency requirements. The infrared spectrum may be divided into three sections: the *near* infrared lies just beyond the red end of the visible spectrum, to which special photographic emulsions and photo-emissive detectors are sensitive; the *intermediate* infrared extends from the red end of the visible spectrum to the long wave-length cut-off of a lead sulfide detector's photoconductive sensitivity when it is refrigerated by dry ice; the *far* infrared lies beyond the intermediate region.

Design practice for optical components of the near region is much the same as for conventional, visible-light optics. Components of the far region call for exotic optical materials. Our interest centers in the intermediate, or lead-sulphide, spectral region.



SPHERICAL WINDOWS of optical quality can be cold-formed below 300°F. by placing flat preheated CTFE sheets between matched dies (*left*), compressing and then holding the formed material in place until it has cooled to room temperature (*right*).

Ordinary glasses and plastics are not sufficiently transparent in the lead sulphide region; some of the unusual far-infrared optical materials are, but their cost and their mechanical and thermal properties make them unsatisfactory. Furthermore, they are transparent to the longer wavelengths, where transparency is not needed with lead sulphide detectors. Notable among the few materials that offer adequate transparency in the lead sulphide region without the disadvantages of the far-infrared materials, are the polychlorotrifluorethylene (CTFE) thermoplastics such as 3M's Kel-F.

CTFE lends itself better to molding than do the glass-like materials and it is far less susceptible to breakage than they are. It is not without limitations, however: its modulus of elasticity is low, its resistance to abrasion poor, its softening temperature lower than fused quartz; and slight variations in its refractive index may render it unacceptable in high-resolution optical systems. On balance, however, it is worth considering for non-image-forming windows.

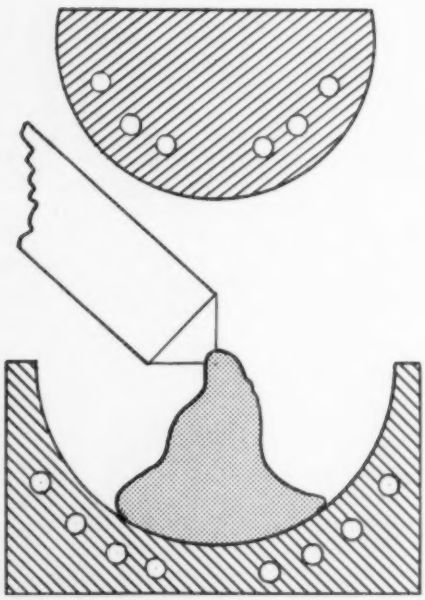
Because of its molding qualities, CTFE can be mass-produced in plain and curved windows, domes, and meniscus lenses. But if its versatility is to be exploited, the conventional compression and injection molding techniques must be modified. In ordinary compression or injection molding, quenching does not take place rapidly enough to make the molded piece adequately transparent. This presents no problem in the case of flat windows up to 3/16-inch thick, for sheet stock of that thickness is commercially available. But for thicker windows, the fused thermoplastic must be quenched with dry ice, or even liquid nitrogen, to obtain sufficiently rapid cooling—it must cool from 420° F. down to 300° in 60 seconds or less, and preferably in 20 seconds or less. In cooling through this temperature range microcrystals form. These centers of crystallization are optical discontinuities which scatter transmitted radiation and give the material a milky appearance. The extremely rapid quenching minimizes the formation of microcrystals.

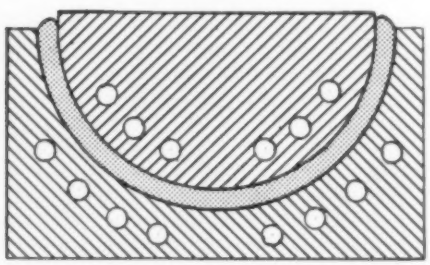
One technique for forming pieces of optical quality is cold-forming at temperatures below 300° F. A flat, transparent sheet is heated to 250° F., placed between matched dies, compressed, and held in place until the formed material cools to room temperature [*see illustration on page 35*]. Spherical windows somewhat less than a full hemisphere, have been molded by this method in a small arbor press with a compressive force of a few tons.

It should be possible to mold deeper domes or meniscus lenses by much the same method, provided the sheet is softened by heating it to 420° F. or higher. The material may be rapidly quenched while it is compressed if the dies are prechilled to 40° F. or lower.

In a second molding method, matched dies are held to a low temperature by circulating ice water, or even a colder liquid, in channels that run through the dies [*see illustration on page 36*]. A predetermined quantity of fused CTFE resin is injected into the cold female mold, and the cold male die is lowered. The material is thus quenched even while it is compressed to the desired form. Compression prevents voids from forming during the rapid thermal contraction that results from quenching.

If the surfaces of the dies are highly polished, the pieces, as they emerge from the mold, will require no final polishing. They will have an overall optical quality limited only by the very slight optical inhomogeniety of the material. The fine grain low density CTFE molding powder is preferable to the high-density pellet form because the latter leave an outline of the pellets on the pieces produced. The surfaces of the dies must, of course, be kept clean and free from scratches, and the finished molded pieces must be handled with care to prevent damage to their surfaces. Should they have to be polished, one of the chief advantages of CTFE over fused quartz would be lost.





INJECTION-COMPRESSION MOLDING technique involves deposit of predetermined quantity of fused CTFE resin from removable injection nozzle into internally cooled female mold (*left*), lowering similarly cooled male die to quench and compress resin to desired form (*right*). Compression eliminates the formation of voids that result from contraction during quenching.

U.S.I. POLYETHYLENE NEWS

A series of advertisements for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

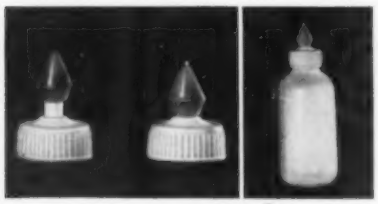
DECEMBER, 1961 — U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation — 99 Park Ave., N. Y. 16, N. Y.

Packaging Notes

Beer in 16-oz. bottles is moving "at a fantastic rate" packaged five to a polyethylene bag, according to a leading New York brewer. The multi-packs are being promoted by suggesting that ice cubes be put into the 2½ mil, re-usable bags to keep beer cold for picnics, outings, etc.

CIRCLE ③ ON COUPON

Non-clogging closure for squeeze bottles is ideal for use with such viscous liquids as glues, detergents and hand creams. Injection molded of U.S.I.'s PETROTHENE polyethylene resin, it features a sliding overcap which seals off orifices when product is not being dispensed. Available in standard diameters of 18, 20, 22, and 24 mm, and in an assortment of colors.

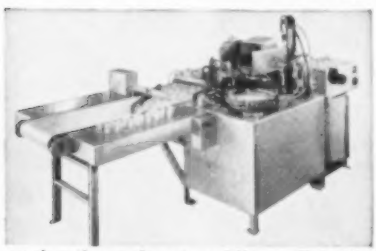


CIRCLE ④ ON COUPON

Bottle finisher, newly available from a Connecticut company, is said to provide clean, continuous cut-off, reaming or chamfering. It handles blow-molded polyethylene containers having neck sizes up to 2" in diameter. Takes only 36" x 30" of floor space. Operation is cycled automatically by foot switch. Loading is manual.

CIRCLE ⑤ ON COUPON

Polyethylene surface treater prepares bottles, vials, novelties for printing, silk screening or labeling. The machine bombards the object with electrical energy,



causing the surface to oxidize sufficiently to permit adhesion of inks and glues. This unit can be incorporated into a conveyor line and adjusted to the production rate. Oxidizing unit requires less power than an ordinary household iron.

CIRCLE ⑥ ON COUPON

Rotational Molders Turning to MICROTHENE® Powdered Polyethylene

U.S.I.'s Finely Divided Resin Offers Significant Economies Over Vinyl Plastisols Commonly Used

MICROTHENE powdered polyethylene, introduced by U.S.I. only about two years ago, has already achieved recognition in the production of large items by powder molding. It is now promising to open new markets for polyethylene in another area: rotational molding of regular and irregular hollow objects. Volleyballs, footballs, baseballs, artificial fruit, pipe fittings, toy horses and bottles are typical.

Rotational molding has been extensively used with vinyl plastisols. In this technique, hollow articles are formed in heated, rotating molds — usually of the multiple cavity type. Existing equipment and operating conditions can be readily adapted for use with MICROTHENE.

Costs No More, Less Needed

While offering a number of advantages over the vinyl plastisols, powdered polyethylene is making more and more converts among rotational molders on the basis of potential savings alone. A large toy manufacturer, for example, switched from a hard vinyl plastisol to MICROTHENE when he discovered he could produce each item for 40¢ less. And another, a maker of toy balls, found that polyethylene offered equivalent performance at a 66% dollar savings.

MICROTHENE sells for 35¢ per pound in truck load quantities in the U.S. — a price comparable to that of the plastisols. But, MICROTHENE has a lower specific gravity (0.92 compared to vinyl plastisol's 1.4), so less is needed to obtain a desired wall thickness. Moreover, polyethylene offers superior stiffness and hardness—making possible even greater weight savings.

Other Advantages

Since no plasticizer is used with polyethylene powder, plasticizer migration is eliminated. MICROTHENE arrives ready for use . . . can be dry blended with pigments to produce colored parts. Also to be considered: *The use of powdered polyethylene in rotational molding applications does not infringe on any patent covering the use of liquid plastisols.*

Samples of MICROTHENE are available from U.S.I. for evaluation; also, technical assistance on its use in either rotational or powder molding.

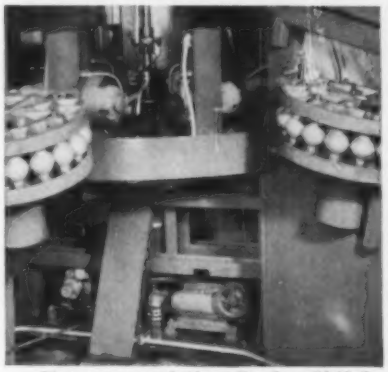


Photo courtesy of Akron Presform Mold Co.

MICROTHENE can be molded in standard rotational molding equipment currently using vinyl plastisols with virtually no modification. An Ohio firm makes this 6-spindle machine capable of producing up to 1620 items per hour.

CIRCLE ① ON COUPON

Polyethylene Paneling Shelters Construction Sites

Bad weather doesn't *have* to interrupt building operations. The protective polyethylene panels, available from an English firm, are designed for use with all types of scaffolding. They can be set up as a complete shelter, as a roof, or simply to screen the windward side of a site as above.

CIRCLE ② ON COUPON

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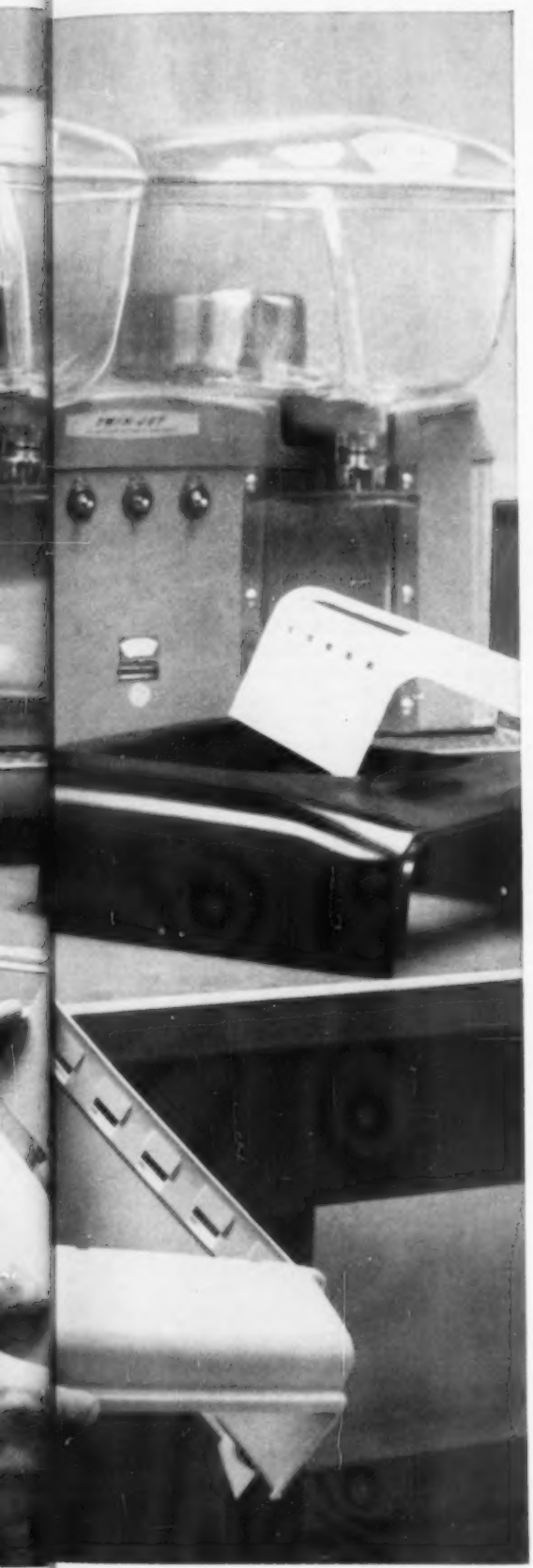

"By selecting from the most complete styrene line we slashed shipping breakage 95% ...cut start-up time 50%"

"Only Monsanto was able to supply the two styrene materials we needed for both overseas and domestic use," reports Mr. Robert B. Thomson, Purchasing Agent at Jet Spray Cooler, Inc., Waltham, Massachusetts. "For domestic requirements, we switched to *Lustrex* for the side panel on our cooler, cutting start-up time 50% and getting the right level of performance with economical cost. For overseas use, we switched to *Lustran*, cutting shipping breakage to less than 1%. Both Lustran and Lustrex work smoothly and completely in the same mold. Components, with dimension and color perfectly matched, are used interchangeably.

Can the broadest line of styrene materials with the widest range of mechanical properties provide a closer match to the price/performance requirements of your applications? By selecting from the only complete line of general purpose, medium impact, high impact, super high impact, SAN or SAB materials you don't have to over-buy or under-engineer. You get the impartial material recommendations that only a supplier with a full line can offer. In addition, you can make savings by combining shipments.

Ask your Monsanto representative to show you how the Lustrex-Lustran line of styrene materials can help you engineer better products at lower costs.

LUSTREX®
Styrene

LUSTRAN®
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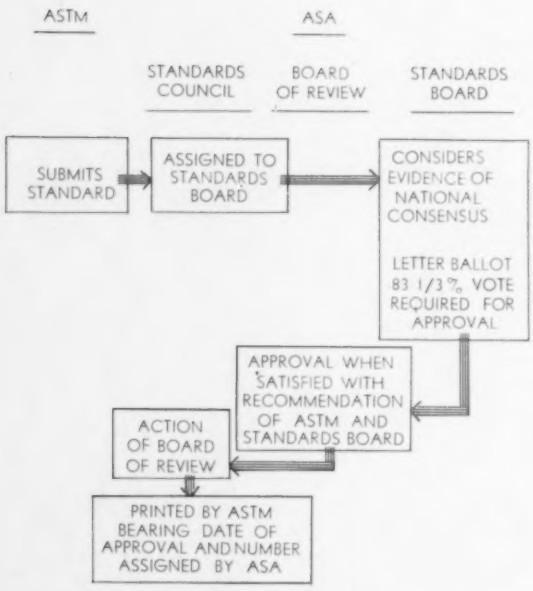
Plastics Standards in the U. S.

Standards are crucially important to industrial growth.

To be effective they must represent a true national consensus

by C. Howard Adams

When man first began to communicate with his neighbor, he was able to do so only because a sign, symbol, or sound, however informal, meant the same to him as it did to the man in the next cave. Both were relying on standards. The plastics industry depends no less on its comprehensive and technically sophisticated standards, which cover test methods, apparatus, terminology, material, and product specifications. Plastics standards result from the collaboration of over 30 industrial and govermental groups. Forty years ago, one, small, technical committee in the American Society for Testing Materials, ASTM, alone shouldered the plastics standardization load. In this early period of the plastics industry's history, its products were more apt to be known by trade- rather than generic-names, and its market was electrical insulation. The pioneering effort of ASTM's Committee D-9 on Electrical Insulating Materials was the foundation[2] upon which other societies and associations built. By the late thirties, the plastics industry had completed its gestation period within the complex of the organic chemical industry and emerged as a separate entity. It was not long in seeking an ASTM technical committee devoted exclusively to its products, and in 1937, Committee D-20 on Plastics came into being. Today, there are some 200 ASTM standards for plastics, and at least 100 others covering products derived from plastics in the textile, adhesive, surface coating, foam, and sandwich-panel fields.


ASTM
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ASTM Standards procedure

ASTM standards for plastics materials play a key role in U.S. technology and business. Plastic product standards originate with ASTM and several other standardizing bodies[3], the National Electrical Manufacturers' Association, NEMA, for example, Society of Automotive Engineers, Underwriters' Laboratories, and several agencies of the U.S. Government. The Commodity Standards Division of the Department of Commerce, with the cooperation of the Society of the Plastics Industry, SPI, has developed a record 18 voluntary commercial standards[4] for such plastics products as flexible polyethylene plastic pipe, melamine dinnerware, polystyrene wall tile, etc.

Other societies involved in plastic standardization include: American Institute of Electrical Engineers, American Institute of Textile Chemists, Illuminating Engineering Society, National Fire Protection Association, Technical Association of the Paper and Pulp Industry, and building code groups, such as Building Officials Conference of America and International Conference of Building Officials.

The American Standards Association, founded in 1918 by ASTM and four other societies, is the top co-

ordinating body and standards-program clearing-house in the U.S. National groups use ASA to obtain nationally accepted standards via approval by ASA as American standards. The ASA federation includes approximately 125 national organizations and over 2200 company members.

In the U.S., plastics standardization is guided by democratic principles. An equitable power balance among the interests concerned is insured: committees turn out definitions, test methods and specifications. An individual with complete responsibility and authority could work faster, but speed is only one measure of performance.

ASTM Standards

The history of U.S. plastics standardization is, by and large, the history of plastics standardization in the ASTM[5]. Most of the standards promulgated by other bodies refer to the work of ASTM plastic-oriented committees, especially that of D-20 on plastics.

The standardizing process in ASTM can be considered typical of U.S. standardizing practice [*see illustration on page 41*]. It is important to note that the procedure described is common to all ASTM standards.

An ASTM plastics standard originates from a need that has been defined and brought to the subcommittee or main committee by a group of concerned members, single members or a representative of an industrial concern or academic laboratory. A task force within an appropriate subcommittee looks into the matter in depth, appraises the validity of the need and develops specific recommendations for action. They further consider if the ultimate product should be a recommended practice or a standard; a distinction that has pertinence only where test methods and supporting technology are involved. A recommended practice, implying that a technology has not sufficiently advanced to make standardization possible, is a useful adjunct to standardization. The recommended practice for injection molding, for example, points out the critical variables in the molding process, but does not attempt to say which combination is best or which can be considered standard for any given thermoplastic molding material.

Action by the subcommittee on the recommendations of the task force constitutes the next step in developing an ASTM committee D-20 standard. If the action is favorable, the chairman decides if the task force should draft a standard or if an already established section is to do the job. Generally, if the work is sufficiently new and unrelated to established programs, the task force will draw the assignment. A draft of the proposed standard is prepared, tested and the supporting data presented through the section to the subcommittee. The draft may be the subject of a letter ballot at the section or task force level. When the section is satisfied the document is workable, it seeks approval through a letter ballot from the wider audience of the subcommittee. If the method, specification, terminology or definition represents marked technological advances, it is usually desirable to present a technical brief giving the background on the standard.

A small group of highly qualified individuals, directly concerned with the industry the standard will serve, work on the task force to draft the standard. When they are satisfied with their standard, they present their work to the larger, less sophisticated audience of the section, then to the still larger and even less-sophisticated subcommittee group, and finally to the full committee. Standards in new areas of technology or on new materials usually reach the committee level smoothly, and are held up largely for draftsmanship reasons. Typical problems are: language that is not clear and concise; mathematical formulas requiring an expert's knowledge or, perhaps, a drawing that does not clearly convey the intended message to the uninformed individual who may typify the ultimate user—pointing up the dual responsibility of those who draft standards. The standard must be technologically sound; on the other hand, it must be written in completely unambiguous language to convey just the right amount of information to enable the user to carry out the test, determine if a material meets a specification, or understand what given words mean in the context of the plastics standardization field.

When a standard reaches the committee level, the balloting has official society status. Though democratic principles have been followed to this point and a balance has been maintained among producer, consumer, and general-interest members, it is at the committee level that the balloting must be documented to show that the votes are distributed equitably among the three interests represented. At this level, a manufacturer of polystyrene, even though represented in D-20 by five or more engineers, would have only one

NEED PRESENTED TO D-20
EVALUATION AND DEVELOPMENT BY ASSIGNED SUB-COMMITTEE
D-20 LETTER BALLOT
SOCIETY ACTION
ADM. COMM. STDS. ANNUAL MEETING
APPROVED AS TENTATIVE STANDARD, PUBLISHED
TENTATIVE STANDARD PRESENTED FOR ADOPTION AS STANDARD
D-20 LETTER BALLOT
PRESENTED TO SOCIETY
LETTER BALLOT ANNUAL MEETING
PUBLISHED AS ASTM STANDARD

From D-20 subcommittee to published ASTM standard

vote. The committee administration maintains a continuous check on the balance among producer, consumer, and general-interest members to insure that its ballots are acceptable to the Administrative Committee on Standards or to the society at the annual meeting, the final arbiters. The society's senior standards' board, the ACS, acts on committee recommendations and judges the merits of objections that have not been resolved at the committee level. Such objections may be voiced by a committee or task group member either in meetings or by ballot, at all stages of the standardizing process. In ASTM, the negative vote is carefully considered since it usually reflects thorough study of the standard by a competent individual, but a negative vote which lacks supporting documentation has no stature and is automatically thrown out.

A standard may be published either as a tentative standard or as one having full standard status. The tentative standard serves a very useful role in ASTM. Identified with the letter T after numbers identifying the year of latest revision, it is under continuous study with a view to advancing it to full-fledged standard status. In the plastics field, many methods have been held tentative for several years, the technology meanwhile advancing to the point where standard status could be granted. In many instances, the tentative has essentially comparable stature to the standard. Though the standard is identified with mature technology, ASTM provides the machinery to keep it in step with technical advances. Some committees other than D-20 which write standards around plastics and high polymer materials include D-9 on Electrical Insulating Materials; D-11 on Rubber and Rubber-like Materials; D-1 on Paint, Varnish, Lacquer and Related Products; C-19 on Structural Sandwich Constructions; and D-12 on Textile Materials.

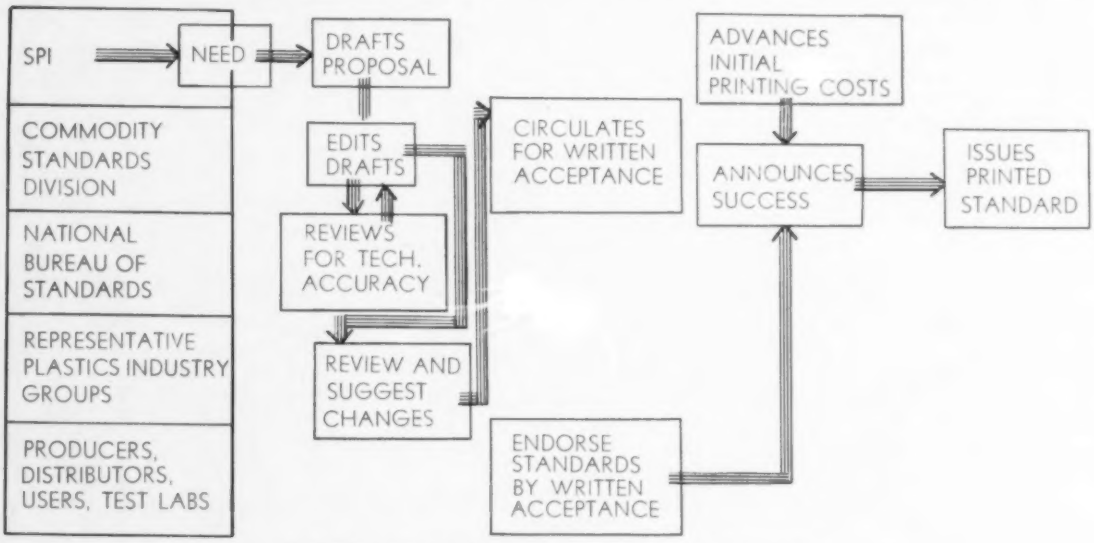
SPI's Role Commodity Standards

The Society of the Plastics Industry supports the work of the ASTM by bringing needs for new standards to the attention of Committee D-20 and participating in many of its subcommittee activities; XVII—Plastic Pipe and Fittings, for example. The SPI's Department of Commerce program[6] has been devoted completely to the development of commercial standards. The objective of the commercial standard is to define quality levels for products in accordance with the principal demands of the trade. There are now some 18 commercial standards for plastics products, and work underway on more than 20 others—the largest number of voluntary commercial standards prepared under the auspices of any trade association.

The illustration on page 42 shows how Commodity Standards are established through the Commodity Standards Division of the Office of Technical Services, Business and Defense Services Administration, U.S. Department of Commerce. Note that a similar sequence of events takes place in the establishment of a Commodity Standard as in the development of an ASTM standard: definition of need, drafting of standard, and circulation for approval by producers, distributors, users, and testing laboratories. This final approval is by letter ballot where the standards are either endorsed or returned for further work with the reasons for the rejections stated in writing.

Government Standards

The U. S. Government is a major factor in American standardization. In addition to the important work done by the Commerce Department through the National Bureau of Standards and the Commodity Standards Division, the military services and the Federal Supply Services[8] of the General Services Administration prepare standards for plastics materials and products. In the development of military specifications and standards for plastics, assignments are made to the interested and concerned military department that has the technical capability to draft the standard. The



U. S. Department of Commerce Commodity Standard procedure

assignments are made by the Standardization Division, Office of the Secretary of Defense, Supply and Logistics. Military specifications may be either coordinated or of the limited coordination type. The coordinated specification is directed at items of common use, and is drafted through the cooperative effort of all interested branches of the military services. Limited coordination specifications in contrast, may be prepared by a single military department, usually the one having an interest in the material or product being specified, and are designed to satisfy an immediate procurement need. Federal specifications and standards preparation projects are assigned to that civilian or military agency that has both the greatest need for the specification or standard and the technical staff to prepare it. Thus, the National Bureau of Standards' Plastics Section is responsible for Federal Test Method Standard 406 on Plastics. The administrative control for Federal specifications and standards rests with the Standards Division of the Federal Supply Service. Federal specifications are for use by two or more agencies of the Government, at least one of which is non-military. Approval of Federal standards and specifications is by all interested governmental agencies, including the Military.

The U.S. Government uses the word *standard*[3] different from industry establishing engineering and technical limitations and applications for products, materials, processes, methods, designs and engineering practices. The specification used in procurement contains clear, precise descriptions of the technical requirements for the item or service, tests used and data obtained that establish product quality and packaging requirements. Although prime responsibility for issuance of these specifications rests with the U.S. Government, its standardizing procedures provide for comment by industry before the standard is used [*see illustration on page 43*].

ASTM standards frequently form the base line for the Government specification or standard. Moreover, personnel representing Government agencies concerned with standards and specifications are active in ASTM plastics standardization work.

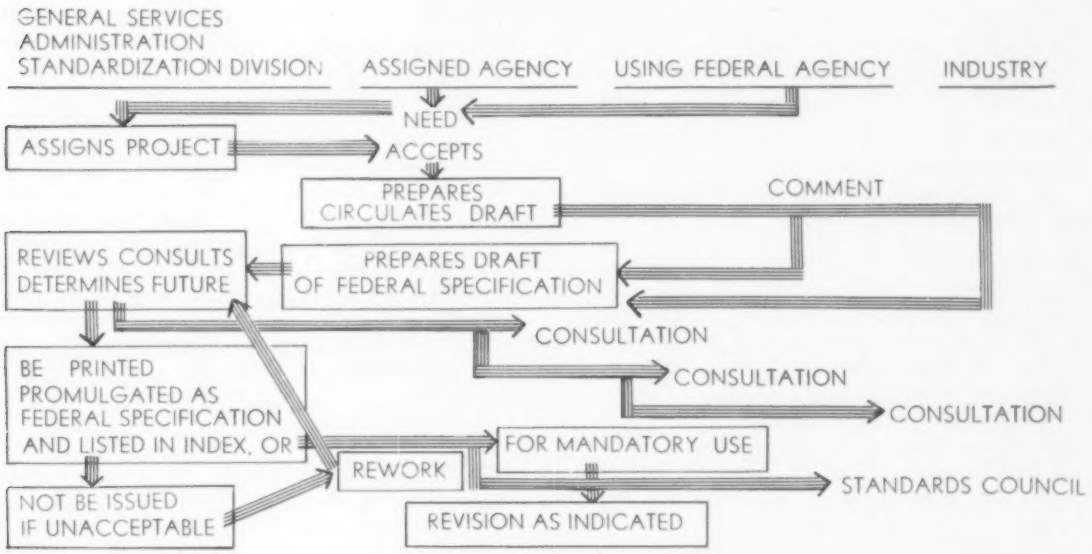
NEMA Standards

The National Electrical Manufacturers' Association, NEMA, drafts[9] and publishes standards on electrical products that include plastics materials. Sections of NEMA work on industrial laminates, decorative laminates, rubber, thermoplastics, insulated cable, transformers, switch gears, and motors.

In the industrial laminate section, work on a standard is originated when three or more member companies make a given type of product. Samples of the product are evaluated by an independent testing laboratory, using ASTM test methods, and, of course, by the individual laboratories of the laminators. Based on these results, standards for electrical and mechanical properties and dimensional tolerances and authorized engineering data are established and are sent to letter ballot of the Industrial Laminated Thermosetting Products Section. When the standard is approved at this level, it is submitted to the Technical Committee of the Association for final letter ballot and approval. The new product standard is then published.

SAE Standards

The automobile industry has long been a strong proponent of standardization through the Society of Automotive Engineers[10]. In developing an SAE standard, need is established in a manner similar to the NEMA procedure: a material or product must be used by two or more companies before it can become a candidate. Standards for plastics materials derive from two sources in SAE: the Aero-Space Materials



U. S. Government standardizing procedure

Division, and the Non-Metallic Materials Committee. An SAE standard is defined as "a documentation of proven and broadly accepted engineering practices." It may consist of specifications for dimensions, material performance, test procedures, inspection, processing, maintenance, or drawing nomenclature.

These committees would probably be most closely identified with standards for this family of materials. They draft the standard, obtain approval within the committee and send it on to the four Councils of the Technical Board who approve the new standard in the name of the society. Some 40 SAE specifications for plastics or plastic-related products have been prepared by the AeroSpace Materials Division. The Non-Metallic Materials Committee has published several additional standards for plastics. Adherence to the SAE standard is strictly voluntary, as is the case with most non-government standards. SAE standards in common with those of NEMA, et al., are coordinated with those of the Federal Government and ASTM.

Underwriters' Laboratories

Underwriters' Laboratories[1] is a non-profit corporation supported by the stock fire insurance companies of the United States. It "maintains and operates laboratories for the examination and testing of devices, systems, and materials, as to their relation to life, fire, and casualty hazards and crime prevention." Because of its objective and independent corporate nature, it can act unilaterally, unlike NEMA, SAE, etc., whose standards one may elect to follow or not. UL's standards are widely used, and several apply to the plastics field.

UL, though in a position to act unilaterally in the drafting of standards, take special pains to enlist the aid of all concerned parties in preparing or revising its standards. Looking through Industry Advisory Conferences, UL seek the advice and counsel of Industry groups. It is important to the plastics industry that such a group on basic plastics materials has been established. At the present time, UL has a very extensive plastics program underway. Supported by the Plastics Committee of the Manufacturing Chemists' Association, its objective is to determine the engineering and fire performance of plastics materials. While UL standards do not have the stature of law in themselves, many communities incorporate them in their building codes, thus giving them a legal status.

ASA American Standards

As of mid-1961, there were over 40 American Standards Association standards for plastic materials and products. At least 35 of these had their origin within ASTM, the balance came from ASA sectional committees. ASA[11] may adopt standards already in existence, such as those of the ASTM, or it may accept those prepared by sectional committees or approved by conferences. An example is ASA's Z26.1-1950, *Safety Glazing Materials for Glazing Motor Vehicles Operating on Land Highways.*

The most common way for an ASTM or other standard to become an ASA standard is through the existing standards procedure. This procedure was followed by the U.S. National Committee for the International Standards Organization, Technical Committee 61 on Plastics in the late 1950's when it wanted certain ASTM methods adopted as ASA standards. These have the stature of national standards in ISO 'work. In following the existing standards procedure [*see illustration on page 40*] ASTM submits the desired standards to ASA for approval through its Standards Council, which then assigns the request to the Standards Board. The Standards Board considers the evidence of national consensus, designates the sponsors, and takes a letter ballot. An 83-⅓ percent affirmative vote is required. The Standards Board then passes its recommendation to the Board of Review which, upon approval, recommends favorable action to the Standards Council. Approval at the Standards Council level authorizes publication. The standard may be published by the submitting organization or by ASA. All ASTM-ASA plastic standards are published by ASTM and carry the ASA number with the ASTM identification.

The Sectional Committee procedure is somewhat more involved than the one for existing standards. The definition of need step is a formalized one requiring action by the Standards Council and the Standards Board. If the need, as presented by any responsible organization, is viewed with favor, it is assigned to a sponsor—a technical society, trade association, or government agency—who organizes and maintains a Sectional Committee; B-72 on Plastic Pipe is such a committee. The committee is made up of representatives from other technical and trade societies, professional groups and government agencies that are substantially concerned. As with ASTM, consumer-, producer-, and general-interests are about equally represented on the committee. A standard coming out of a Sectional Committee must evolve through a series of steps much like those involved in the ASTM, except that the ASA Standards Council, acting through its Board of Review, is the final authority for issuing approval on an American Standard. Complete unanimity must be achieved or, failing that, support for the proposal must be so substantial that it may be considered representative. The sponsor acts as the transmittal agency between the Sectional Committee and the Standards Board. The standard may be published by the sponsor or by ASA with the number assigned by ASA. The automotive glazing standard was developed in this way.

A third method of promulgating an ASA standard is through the General Acceptance System. This is generally held in reserve for the less-complicated type of standard. These are discussed and agreed upon only at a general conference and then published as ASA standards.

Regulatory Body Standards

U.S. building codes reflect another type of standardization. The first plastics section in a building code dates from about 1953. Building codes are prepared by several non-profit organizations in the U.S. including

the Building Officials' Conference of America[12], the International Conference of Building Officials[13], the Southern Building Congress[14], the National Board of Fire Underwriters[15], and state and municipal groups. Their work is done on a basis similar to that of other standardizing bodies; that is, established needs lead to project activity and standards that are agreed upon democratically. These standards form the basis for state and municipal legislation.

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Encapsulating Electronic Subassemblies

Silastic and polyurethane foam are two materials that solve a variety of stringent environmental problems: both give excellent protection against moisture, shock and vibration. They are used in combination for some purposes and separately for others.

Silastic that is cured at room temperature is used to encapsulate electronic subassemblies that include terminal boards and subassembly chassis. Some RTV Silastics are transparent when cured permitting visibility of the encapsulated component.

RTV Silastic is a two-agent-mix silicone rubber which vulcanizes at ambient shop temperatures. When cured, it stays resilient within —70° to 500°F.

RTV Silastic is easy to use and requires few tools and facilities; it is not toxic; the two agents are hand-mixed without an exothermic reaction. Its shelf life, however, is only four months and it is heavy with a specific gravity of 1.12.

The encapsulation of equipment in rigid polyurethane is actually a molding operation: the subassembly is placed in an aluminum or steel mold and the agitated foam is poured in and around the subassembly. The rigidity of foam is advantageous insofar as all internal parts within a block of foam are part of a single mass. These blocks, therefore, can be designed to interlock.

Polyurethane foam is also a two-agent mix, but with a highly exothermic reaction exceeding 300°F., and requires an oven cure at 125°F. Its specific gravity, however, is approximately .2. To justify encapsulation with foam, a total low weight and reduced size of the ultimate encapsulation is important.

Silastic only adheres to materials containing silicone; it can be removed easily to make repairs and then repatched. Silastic can be made to adhere to many metals and thermosetting plastics by applying a primer of raw Silastic and thinner, xylol or xylene.

Polyurethane foam, however, is extremely adhesive to all surfaces, thus the failure of a part requires the complete replacement of the subassembly. Since foam does not adhere to Silastic, a thin coat of Silastic must be applied to a subassembly before foam encapsulation. The foam can then be chipped away to make repairs on the subassembly.

HERCULES **Plastics Hi-Lites**

Pro-fax® proves precisely right

A must plastic for many new uses, Pro-fax always provides the most plastic, too

Because it offers advantages never before available in a thermoplastic, Pro-fax polypropylene has become a "must" for many new uses. But not for exactly the same reasons in every instance. Versatile Pro-fax has many important features unique in its price-property class, and often just a single one of them is ample justification for its usage. Sometimes heat and chemical resistance are the all-important "musts." Again, the economies made possible by the built-in Pro-fax hinge have been foremost in prompting its selection. Its light weight and resilience have on many occasions been prime reasons for specifying Pro-fax.

Whatever the "must," Pro-fax invariably also provides the *most* in a modern construction material. Lightest of all plastics, it yields the most plastic product per pound. Its many innate plus features, in terms of properties, processability and cost, always add up to big value in functionality... merchandising appeal .. and consumer satisfaction.

Pro-fax is in the picture when heat resistance is a "must"

Resistance to heat from the projector light made Pro-fax a "must" for "Duo-jector." This new magnifier-projector for slides, artwork, photos, coins and stamps has a host of other plus features thanks to Pro-fax: compact, attractively styled, readily portable—since it's made with the lightest of all plastics—Duo-jector is virtually unbreakable, with a rich, colorful finish that is immune to staining and will withstand both use and abuse.

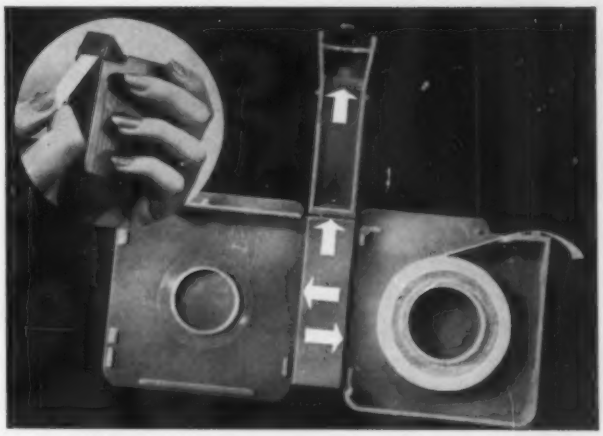
Molded by Como Plastics, Columbus, Indiana, for Rainbow Crafts, Inc., Cincinnati, Ohio.

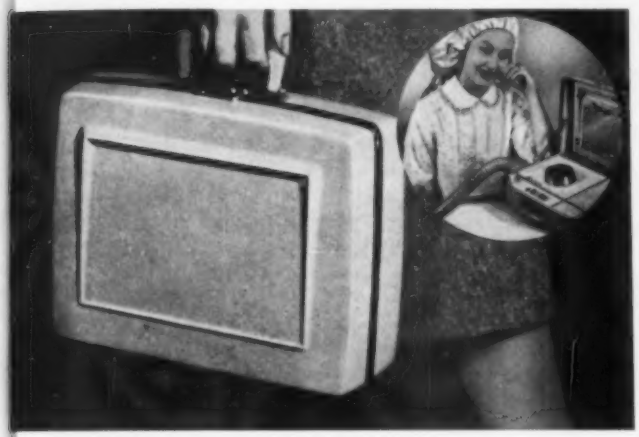
Pro-fax hinges dispense with assembly costs

Pro-fax was a "must" in this unique dispenser-package for Permacel's RIBBON DOPE* Thread Sealant, a new sealer designed for use on threaded pipe joints. Four integrally molded hinges are combined in a single molded part which opens to accommodate a roll of RIBBON DOPE, then folds and locks together to make a lightweight compact carrier. A snap-in blade cuts tape to any desired length, and the handy unit can be tucked in pocket or tool box, stored in any convenient place, or kept available on the worktable. When product success hinges on functionality plus low cost, Pro-fax provides the *most* plastic for the job.

*Trademark of Permacel

Molded by Pyro Plastics Corp., Union, N. J., for Permacel, New Brunswick, N. J.





DOMINION makes a case for Pro-fax in portable home appliances

All of the advantages of Pro-fax which make it ideal for luggage—light weight, resilience, resistance to scuffing and staining—were needed in the case for Dominion Electric's new hair dryer. But UL listing was required, too. Dominion achieved this by the use of an intumescent coating, applied to the interior surface of this handsome injection-molded carrier. Result: A revolutionary new appliance, a veritable portable beauty salon, easily moved, usable anywhere.

Molded by Compro Company, Canton, Ohio, for Dominion Electric Corp., Mansfield, Ohio.

Many "musts" make Pro-fax the most

The combination of properties available in Pro-fax made this radical new concept in laboratory equipment a reality. Six of these molded "drawers," each holding nine culture tubes, nest in a compact case which permits handling 54 tubes at one time. They replace a cumbersome metal rack which required individual handling of each tube under the microscope and during subsequent cleaning and sterilizing. Pro-fax was a "must" for the resilient retainer rings which anchor test tubes firmly in place so that a full drawer can be studied, washed, and steam-autoclaved without removal. Pro-fax was a "must," too, for the built-in hinge catch on each drawer, designed to hold it in the six-drawer case. All these many "musts" have made Pro-fax the *most* plastic for a variety of new laboratory-ware applications, including test tubes, beakers, and a number of measuring devices.

Molded by Philadelphia Plastics and Manufacturing Co., Phila., Pa., for Advance Scientific Corp., Phila., Pa.

HERCULES POWDER COMPANY

Polymers Department
Hercules Tower, 910 Market Street, Wilmington 99, Delaware

GP61-3

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PLASTICS TECHNOLOGY
EXPLORING FABRICATION TECHNIQUES

By L. J. ZUKOR, *ENGINEERING EDITOR*

Biaxial Orientation Of The Vinyls

Vinyl manufacturers and processors are not complacently sitting by while storage costs for surplus resin eat up profits. They are instead trying to move their huge surplus to market. Resin producers, in an effort to expand existing markets, reclaim lost markets, and find new competitive markets have dropped the prices of polymer. The market for flexible packaging film, for instance, is one that vinyl processors helped develop only to find other, cheaper resins of greater specific volume—cu. in. per lb.—displacing their material.

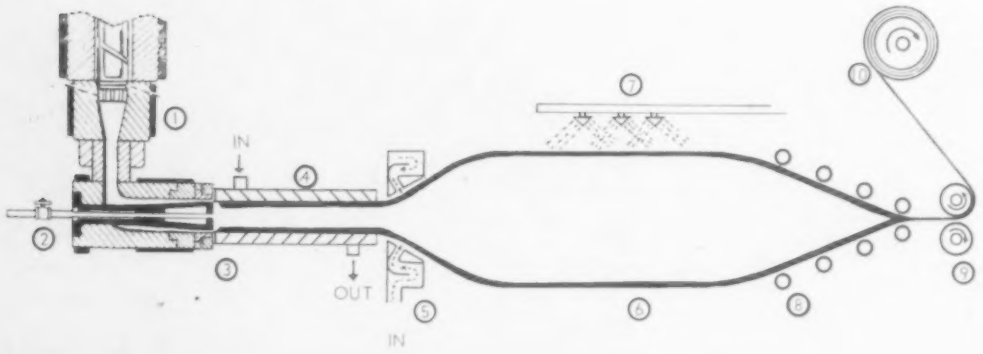
Many processors, reevaluating their marketing position in the light of the new price of vinyls, find that resin price alone cannot yield a competitive film price. They have also to consider processing costs. For a film to be competitive, it would have to be made essentially of an unplasticized homopolymer or a comparably priced copolymer resin with little or no additives. It would, moreover, have to be biaxially oriented if it is to have physical properties comparable to competing films.

Shops with calendering or casting equipment are or are planning to augment the output of these machines with the extrusion process. This is readily understandable, since calendering of vinyl requires the addition of lubricants, stabilizers, and plasticizers in the resin while casting requires that the resin be dissolved in a solvent-plasticizer mixture. The latter process requires a large solvent recovery system, which further increases the cost of processing. Extrusion, on the other hand, is a hot melt process and requires the minimum of additives.

Assuming price equality, it's not difficult to guess which film would be chosen by packers: since the vinyls, of all the polyethenic resins, offer the best combination of properties for packaging films. Their water-vapor and gas transmission rates are lowest, chemical and heat resistance rates highest; they are printable, solvent or heat sealable, and clear; and many vinyl films have F.D.A. approval, attesting to their non-toxicity.

Consider, for example, a vinyl cloride homopolymer of intermediate or high molecular weight. Such resin offers many advantages in film forming, but is difficult to work unless plasticized. Low-molecular weight resins are also available; they are less difficult to work but have lower impact strengths and while they would not make good transparent films, they could be used in translucent or opaque films. Unplasticized intermediate —or high-molecular weight PVC, even when reduced to a one-mil film, exhibits relatively low tensile and impact properties unless biaxially oriented.

In common with many other polymers, orientation



Schematic diagram of blown film orienting unit suitable for ethylene and the vinyls. 1) Extruder shown rotated 90° into 4) refrigerant heat exchanger unit; 5) hot air blast to resoften 7) dry-spray type water nozzles; 8) guide rolls for flatening

Diagram courtesy: Lion Laboratories

many thermoplastic materials such as polypropylene, H. D. polypicture frame; 2) chilled air inlet; 3) annular tubing die; film prior to stretch; 6) biaxially oriented tubular bubble; tubular film; 9) draw-down rolls; 10) take-up reel.

greatly increases the tensile and impact strengths of vinyl films. Vinyl film and sheet producers are well versed in the techniques of biaxial orientation. Twenty years ago, Dow started manufacturing an oriented vinylidene—vinyl cloride copolymer film. This copolymer, which they named saran, is an 85:15 mixture of the two monomers.

Orientation yields two basic forms of film—tubular and flat. [*See Exploring Fabrication Techniques,* PLASTICS TECHNOLOGY *Nov. '60, Jan. '61, Oct. '61*]. The tubular orientation process is basically the extrusion, from a round die, of a cylindrical shape that is later expanded. Flat film can be made by either of two processes: stentering and rolling. Patent literature is filled with design variations of these basic forms. All are combinations of the flat and tubular shapes; both are variations of the blown tubular shape.

Vinylidene cloride, the basic ingredient in saran, is a crystalline polymer that presents problems in crystallite growth [*see Biaxial Orientation of Polypropylene,* PLASTICS TECHNOLOGY, *October 1961, Page 44*]; PVC, on the other hand, like polystyrene is an amorphous (non-crystalline) polymer.

Dow makes *Saran Wrap* film by its proprietary tubular extrusion method, which automatically orients the film molecules along both axes simultaneously. Orientation occurs when the tube is expanded by air pressure, and, at the same time is stretched longitudinally in the nip of the draw-down rolls. Altering either the blow pressure or the speed of the draw-down rolls, varies machine direction, or M.D., and traverse direction, or T.D., orientation. The absence of selvedge or edge scrap is another advantage of the blown tube process. The main disadvantage of the process is that it is slow—half the speed of a comparable flat film operation. Both quenching and heat-setting, or annealing, are difficult to perform in the blown-film method. When tubular film must be restrained during the heat-set operation, it must usually be worked flat in a secondary stentering operation.

John Alexander, Plant Manager of the Plastics Div. of Reynolds Metals Co., in Grottoes, Va. recently showed me his company's band-casting and orienting operations. Here film is made by spreading a solution of either a homopolymer or copolymer resin onto a continuous stainless steel belt. As the belt passes through an oven enclosure, the volatile solvent (tetrahydrofuran THF) boils off and recycles through a solvent recovery system. This process allows considerable variations in compounding. Plastisols and other additives readily mix with the dissolved resin to produce different film types. Film thickness is controlled by varying the belt speed and the feed opening in the dam. In another variation, a reverse roll coater deposits a film of the viscous solution onto the belt.

The Polaroid rolling machine [*see Biaxially Oriented Polypropylene,* PLASTICS TECHNOLOGY, *October 1961*] has been used to orient Reynolds' cast polyvinyl alcohol film. The Polaroid Corporation uses this polymeric film in its polarizing optical equipment.

An unstabilized, high molecular weight vinyl cloride polymer is thermally degraded by normal processing temperatures. Consequently, a process that offers this material, and offers it with the least amount of stabilizer, lubricant and plasticizer, is the one that processors most desire. A compound made with 2-3 phr. stabilizer; 1-2 phr. lubricant and 1-3 phr. plasticizer will yeld a good film by calenderng or extrusion—but not without difficulty. Film made by these processes could tear while being oriented, since there is always the possibility that hard gel formations, or fisheyes, which might resist stretching, are present. The same material, however, can readily be cast and then oriented, but the cost of operating with solvent must then be considered in the final price for the film.

Like other polyethenic resins, vinyl compounds block; although an unplasticized, oriented film blocks less. But when vinyl film is drawn to thicknesses less than one mil, its blocking characteristic is similar to that of polyethylene. In other than cling-type films, however, the addition of anti-block compounds, modify the blocking characteristic.

The casting method produces a film of high tear strength. The film is a homogeneous mixture of polymer and additives, free of fisheyes and other hard gel inclusions often found in both extruded and calendered sheet: it is free of internal strains which makes it par-

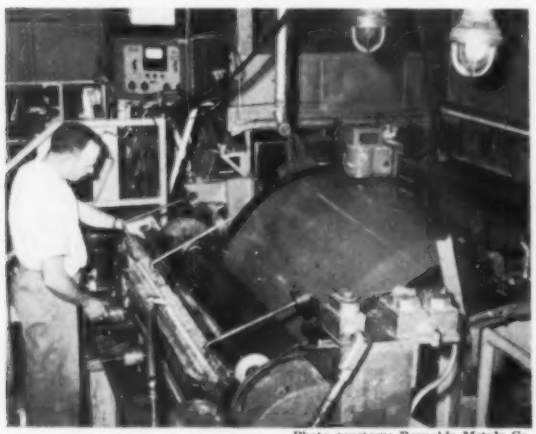


Photo courtesy: Reynolds Metals Co.

Band caster using a reverse roll coater to place a film on the continuous stainless steel belt.

Photo courtesy: The Pantasote Co.

Conveyor feeding vinyl compound to first milling rolls of a large calender unit.

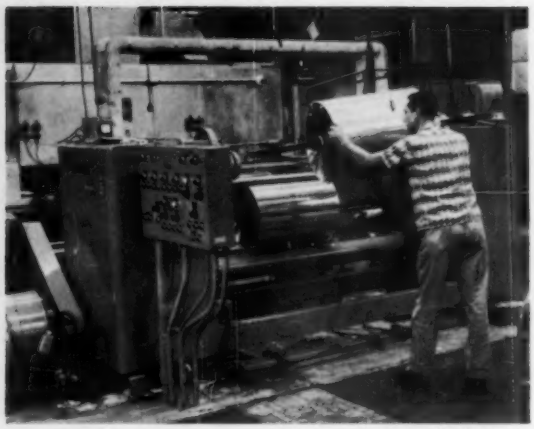


Photo courtesy: Reynolds Metals Co.

View looking toward M.D. orienting rolls from which film automatically feeds into the clamps of the stenter frame.

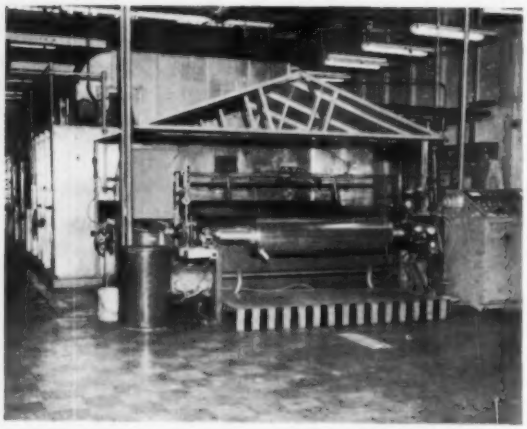


Photo courtesy: Reynolds Metals Co.

Take-off end of stenter frame showing reel skewing mechanism, and vacuum tubes for selvedge removal.

ticularly well adapted to a secondary stentering operation. At the time of my visit, a vinyl cloride-vinyl acetate copolymer was being cast. During this operation, a split roll of film, peeled from a band-caster, was being set up to feed the stenter unit.

The Reynolds' stenter frame, its oven enclosure, the M.D. orienting rolls, infeed reels and take-off reels are set in-line in a clear, clean area. One of the finest things about this plant is its good housekeeping practices and its orderly arrangement of machines and stock. As I watched, the operator fed film into the M.D. orienting rolls then by manipulating one edge of the film, he fed it into the clamps of the stenter frame, which in turn carried it through the T.D. orienting section and out to the take-up reel.

The plant was so laid-out that a battery of band-casters could conveniently feed material to each of the stenter frame units. Temperature readings during the stentering operation and at about 300 percent stretch, were: 200°F. (or within 170° to 250°F. depending on the composition of the resin) for M.D. stretch; 250°F. (or 200° to 270°F.) in the first section of the stenter frame—the temperature in this zone is increased for rigid materials, and decreased for plasticized materials; 225°F. (200° to 270°F.) in the second, or stretch, zone—temperatures are slightly lower in this zone to balance a heat carryover from the previous zone; 240°F. (210 to 290°F.) in the last or annealing zone of the heated enclosure where the clamps again run parallel—restraining the film with no applied force. Lowering the temperature in the last zone, yields a shrink type film.

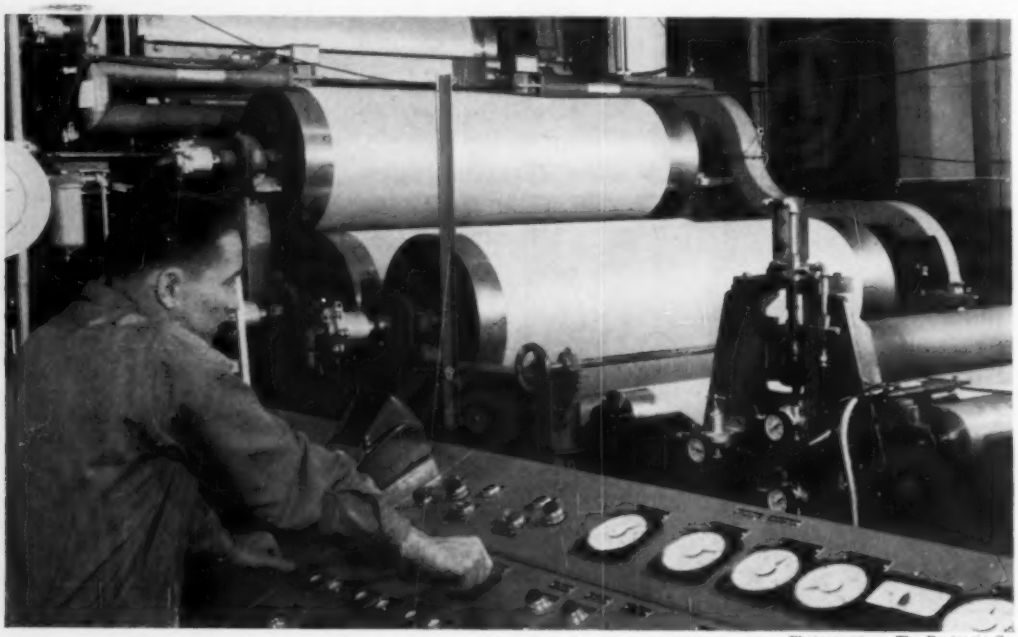


Photo courtesy: The Pantasote Co.

View at control panel of Pantasote's huge calender; showing cooling rolls and nuclear-type thickness gage and controls.

opinion:

The Custom Molder vs. The Captive

by Donald F. Dew

Is there a future for custom molders? Of course there is, to the same extent that there is a future for the corner grocery stores, small independent drug stores and job-shop insert suppliers.

The real questions are: How many molders can our industry support in a way that is financially sound and profitable? Is a shop to have 20 or 1,000 employees? What kind of management should it have? The traditional owner-manager combination, or should it go corporate and thus get the double return—the return from its investment and the return for its managerial services? And beyond this, how profitable is the industry going to be?

These questions can't be answered without considering the captive operations. As long as there are large companies buying large numbers of parts and spending a lot of dollars, there will be those among them that think they can do it cheaper for themselves. The events that lead up to that decision probably run something like this:

A vice president walks into the president's office and says: "We are buying more than a million dollars worth of plastic parts; I think we can make them ourselves for about 20% less: Here's how: our plastics supplier probably makes at least six to eight percent before taxes, so we can immediately eliminate his profit. On a million dollars, that's a fair hunk of change. Secondly, we can take somewhere between one and two percent out of our costs because we will no longer have to pay transportation. Thirdly, we don't have the general sales and administrative costs that the custom molder has. Finally, our pure manufacturing costs ought to be considerably less than the custom molder's because we would have long runs. We would also do away with his designers and engineers because we'll be able to get all the dope we need from material and machinery suppliers. The storage building in back of the plant has about 10,000 square feet. I think that would be just about right to set up a three-, four- or five-press operation. About $350,000 of capital investment ought to do it. We're in business."

That happens, and the custom molder is sick, sick, sick. He has really had it. He sees a half-million dollars fly out the window, and two or three years of financial problems fly in. He has to realign his sales and his administrative costs. Our own company went through this in 1954. But surprisingly, when we look back at it now, we find that we are stronger because of it.

Our industry is not a shrinking one; indeed, it is growing so rapidly that there is ample opportunity to replace lost volume. We may not be able to replace it in the same way, or in the same area, or perhaps not even with the same plastics. But we can replace it because there are more plastics being produced this year than last year, and there will be more next year than this. Give these firms who go in for the captive operation three, four or five years, then go back and talk to them. If our experience is any measure, more than a third of the business that went captive will come back out of captive. This is what happened at GE, Westinghouse, and the Weston Division of Davstrom. We ourselves have had several molds returned in the last three years that had been taken from us by captive molders.

Don't try to fight city hall, but on the other hand, don't think all lost captive business is permanently lost —it isn't. Generally speaking, the captive molder simply cannot get all the dope he needs from the material supplier or the machinery supplier. You may have a splendid opportunity to sell an engineering service or a better product if you will be patient and go back to your former captive customer in two or three years.

The custom molder must choose his direction early in his career, and either stick to it or change his line of sight. He must size his business, and not let it size him. If he wants to be big, he must do it by divisions. If he wants to have a five- or ten-million dollar operation, he should separate the business in many ways; put the thermosetting in one place, for example, and the thermoplastics in another. If he doesn't have a tool room, he should get one and make it into a third corporation. I believe that many companies have permitted their business to size them, and that's dangerous.

Companies in other industries don't put dollar bills in every carton they ship out. They may like their customers very much; they may think they've got a future with them, but they don't normally, for any great length of time, put dollar bills in cartons. We custom molders do just that, simply because we don't know our costs. Those of us who become better educated in the ways of cost accounting, will be able to work with a better margin of profit after taxes than we do now. Those of us who fail to learn the lesson will be forced out of business.

But the most important factor is your desire to sell. Make sure you sell something. You've got some engineering service—sell it; you've got some skill—sell it; you've got some experience—sell it. This is the market concept that we custom molders have been talking about. Sell that concept and you've got a future.

New Materials

Service Item numbers refer to numbers on Readers' Service Card facing page 78

High density polyethylene for cellular insulation

A new high density polyethylene compound, Bakelite DGDA-2580, specifically designed for thin-walled cellular primary insulation stronger and tougher than that made for solid, low density polyethylene, has been announced by Union Carbide Plastics Co. Cellular DGDA-2580 has a dielectric constant between 1.5 and 1.7, or slightly more than half that of solid materials and the cellular construction does not affect the moisture resistance of insulation made from the compound, which is excellent, as is its low temperature flexibility.

The low dielectric constant means that telephone singles insulation may be made with reduced wall thickness, which allows a reduction in size and weight of the overall cable. Thus, less outer jacketing is required and more cable can be wound on a reel. Also, use of the new cellular PE instead of solid PE results in a considerable reduction in material costs; for one construction DGDA-2580 costs about 82c a mile, solid PE costs $1.28 per mile of single.

DGDA-2580 should be useful also as insulation for high frequency applications such as video pairs community coaxial cable and antenna lead-in, and as bedding for insulated members to fill out multiconductor cables. The properties of cellular DGDA-2580 are compared with cellular polypropylene, both containing about 30% gas by volume, and with solid low density PE insulation in the table below:

	Cellular DGA-2580	Cellular Polypropylene	Solid low density PE
Tensile strength, psi	2800	3100	2200
Elongation, %	300+	300+	300+
Mandrel bend (2X), °C.*	<−70	−40	<−70
Brittleness temp., °F., °C.**	<−90	+10	<−90
Power factor			
1 kc.	0.0012	0.0023	0.00018
50 kc.	0.0009	0.0025	0.00020
1 mc.	0.0006	0.0021	0.00023
Dielectric constant			
1 kc., 50 kc., 1 mc.	1.5–1.7	1.5–1.7	2.28

* Lowest temperature passed
** Values obtained on solid pressings.

Item 1

Modified polypropylene

Oleform, a modified polypropylene with outstanding toughness and rigidity over a wide temperature range, is available in experimental quantities in one grade, a blue-gray molding resin, from AviSun Corp. The modification consists primarily of the addition of an asbestos-type filler or reinforcement. A fire retardant grade will be available soon. Oleform has high rigidity and heat distortion values, along with excellent dimensional stability and creep resistance, chemical resistance and low moisture absorption, when compared with competitive materials. Electrical properties include an extremely low loss factor and outstanding insulator attributes.

Oleform processes easily, about the same an unmodified polypropylene. It can be injection molded with faster mold cycles than are possible with compression molded thermosets. Surface treatment is required before painting and decorating.

Promising applications for this modified polypropylene include automotive parts, as well as parts for electrical and electronic components, appliances, and wiring devices.

Some of the physical, mechanical and electrical properties are listed below:

Physical Properties	Value
Specific gravity	1.24
Melt flow rate, gm./10 min. 230° C., 2160 gm. load	5
Mold shrinkage, in./in.	0.010-0.020
Heat distortion point, °F.	
66 psi.	295
264 psi.	200
Deformation under load, %	
2000 psi., 122° F., 24 hrs.	1.6
Coefficient of linear expansion, in./in/° C. (−30 to +30° C.)	3.8×10^{-5}
Flammability	Slow burning
Water absorption, 24 hrs., %	0.02
Mechanical Properties	
Yield strength, psi., 1 in./min.	4500
Elongation, %, 1 in./min.	6
Tensile modulus, 10^5 psi., 0.2 in./min.	290
Flexural modulus, 10^5 psi., .05 in./min.	550
Izod impact, ft.-lb./in. notch	0.8
Hardness, Shore D	75
Electrical Properties	
Volume resistivity, ohm-cm.	1.5×10^{15}
Dielectric strength, volts/mil Short time, 125 mil thickness	450
Dielectric constant	
60 c	2.75
1 kc	2.65
1 mc	2.60
Dissipation factor	
60 c	0.0074
1 kc	0.0046
1 mc	0.0019
Loss factor	
60 c	0.020
1 kc	0.012
1 mc	0.005
Arc resistance, secs.	121

Item 2

H-D, high melt-flow polyethylenes

Three new high density (0.962), high stiffness, Ziegler-type linear polyethylenes for high melt index application, Hi-fax 2000, 2100, and 2200, have been added to the Hi-fax 2000 series by Hercules Powder Co. Hi-fax 2000, 2100, and 2200 have nominal melt indexes of 9.0, 5.0, and 3.5, respectively as compared with Hi-fax 2300, 2400, and 2600 with melt indexes of 1.5, 1.0, and 0.2, announced in June 1961.

The new Hi-fax 2000, 2100, and 2200 with high melt-flow values now make it possible to employ the high-range physical properties inherent in the Hi-fax 2000 series in such applications as film, paper-coating, and medium to large shot injection molding. Hi-fax 2000 brings maximum rigidity and flexural stiffness to film and paper-coating applications. Although heat distortion temperatures are higher, heat sealing by any of the conventional methods is not adversely affected. The Hi-fax 2000 series in high melt-flow ranges makes possible economical injection molding on practical cycles of medium to large shot items which are adequately stiff in thin sections without becoming brittle and subject to flex-cracking. Hi-fax 2000 offers easiest molding, with no sacrifice in stiffness and hardness, and with little loss in tensile yield strength. The lower melt-flow resins permit designing to take advantage of increased impact with compromises in moldability.

Some typical properties of Hi-fax 2000, 2100, and 2200 are listed below:

Properties	2000	2100	2200
Melt index, I_2 at 190° C.	8.9	4.5	3.5
Density, 20° C., g./cc.	0.964	0.962	0.962
Hardness, Rockwell R	66	64	65
Izod impact strength, notched, ft. lb./in.			
23° C.	0.8	1.8	2.8
−40° C.	—	0.7	0.8
Heat distortion temp., °C.			
66 psi	87.0	84.5	83.5
264 psi	52.5	52.7	51.5
Tensile yield stress, 0.2 in./min., psi, 23° C.	3,200	3,300	3,100
Tensile modulus, 0.2 in./min., psi, 23° C.	148,500	152,000	146,000
Ultimate elongation, 0.2 in./min., %, 23° C.	900+	900+	900+
Stiffness in flexure, psi, 23° C.	129,500	137,000	141,000
Flexural modulus, psi, 23° C.	160,000	160,000	160,000
Stress crack, hr.	10	10	10
Mold shrinkage, length			
1/16-in. strip	0.021	0.022	0.025
1/4-in. bar	0.023	0.023	0.022
1/8-in tensile bar	0.017	0.021	0.023
Mold shrinkage			
direction of flow	0.025	0.026	0.027
opposite of flow direction	0.019	0.019	0.019

Item 3

SELF-EXTINGUISHING EPOXY RESINS

The use of versatile epoxy resins based on bisphenol A and epichlorohydrin will be considerably broadened by the recent Dow development of self-extinguishing epoxy resins. Dow Research elected to introduce halogen directly into the epoxy molecule, instead of using halogenated curing agents or depending on fillers to attain this characteristic. With the resin contributing the self-extinguishing properties, epoxy formulators are free to utilize any curing agent and filler systems needed for the host of epoxy end uses.

This approach, halogen on epoxy, is not a new approach to self-extinguishing characteristics, but in the past has generally resulted in too great a sacrifice of other physical properties. The new Dow epoxy resins containing bromine, however, provide excellent self-extinguishing properties with *little or no loss of other desirable properties.*

Ordinarily, a bromine content of 15-25% will render even an unfilled casting suitably self-extinguishing. Of course, variation in curing agents, concentration, addition of fillers and fibers, and variations in operating environment will require deviations in the bromine content range.

Two brominated epoxy resins are offered by Dow: Experimental Resin X-3442, a semisolid; and X-3441.1, a solid, similar in physical form to D.E.R.® 661 resin. Physical properties of these resins are given in Table I.

Experimental Resin X-3442, with nearly 50% bromine by weight, is designed for blending with other resins. Test data on castings were determined using blends of 50 parts X-3442 to 50 parts D.E.R. 331. Experimental Resin X-3441.1 can be used either alone or in blends with conventional resins such as D.E.R. 661 resin. It has particular utility in pre-preg laminating since it handles by conventional methods in use for standard solid epoxies. The testing of X-3442 and X-3441.1, and of their blends with other epoxies, revealed that physical properties developed by these brominated resins are very similar to those developed by conventional epoxy resins, except in isolated cases with specific curing agents. In the case of clear castings of 50/50 X-3442 and D.E.R. 331, a loss of flexural strength was found at 300°F. However, standard epoxy resins show similar losses at this temperature, with identical curing agents.

It can be concluded from the studies that the Dow self-extinguishing epoxy resins can replace enough conventional epoxy in any formulation to provide self-extinguishing characteristics, with little or no degradation of the mechanical or electrical properties. Partial technical information obtained during the tests is reproduced below.

For full data and information on the Dow experimental self-extinguishing epoxy resins, write Coatings Materials, Plastics Sales Department 1956DT12.

TABLE I

Physical Properties of Experimental Self-Extinguishing Resins*

Experimental Resins	X-3442	X-3441.1
Physical Form	Semisolid	Solid
Viscosity 150°F, cps.	160,000	—
25°C, 80% N. V. in MEK, cps.	—	3,120
Durrans Softening Point, °C	53	73.5
Epoxide Equivalent Weight	365	476
Specific Gravity 25/25°C	1.79	1.40
Color, Gardner	11	—
80% N. V. in MEK	—	6-7
Bromine Analyzed, %	48.7	18.7

*These are typical properties, not specifications.

TABLE II

Physical Properties of Typical Unfilled Castings Formulations

Formulation Resin	D. E. R. 331	X-3442/D. E. R. 331 50/50
Hardener, Conc. phr	NMA/BDMA-86/1.5	NMA/BDMA-62/1.5
Gel Time, 50 gm. at 212°F	—	19 min.
Post Cure	4 hrs @ 175°F + 15 hrs @ 300°F	4 hrs @ 175°F + 15 hrs @ 300°F
Physical Properties		
Heat Distortion Temp., °F	284	286
75°F Flexural Strength, psi	14,300	15,800
Modulus	$.487 \times 10^6$	$.473 \times 10^6$
300°F Flexural Strength, psi	880	550
Modulus	$.470 \times 10^4$	$.287 \times 10^4$ *
75°F Compression Strength, psi	37,500	37,750
Modulus	$.407 \times 10^6$	$.399 \times 10^6$
300°F Compression Strength, psi	32,000	33,000
Modulus	$.750 \times 10^4$	$.651 \times 10^{4}$**

*Yielded, but did not break
**Compressed 50-75% before disintegrating
NMA—NADIC methyl anhydride
BDMA—Benzyldimethylamine accelerator

TABLE III

Self-Extinguishing Characteristics of Typical Pre-preg Laminates

(Curing agent—dicyandiamide)

Resin System	Ratio	ASTM D-635 Burning Time, Seconds
X-3442/D.E.R. 661	20/80	0-5
X-3442/D.E.R. 661	30/70	1-5
X-3441.1	100	—
X-3441.1/D.E.R. 661	75/25	1-3
X-3442/D.E.R. 661	20/80 + Antimony Oxide	0-4
X-3442/D.E.R. 661	15/85 + Antimony Oxide	7-12
Curing agent, MDA, 20 phr, wet lay up		
X-3442/D.E.R. 331	50/50	0-1
Curing agent, BF_3-MEA, 3 phr, wet lay up		
X-3442/D.E.R. 331	50/50	0-1

THE DOW CHEMICAL COMPANY DOW Midland, Michigan

For more information check Readers' Service Card No. 121

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NEW FREEDOM FROM TASTE AND ODOR TRANSFER

Harflex 330 is a non-migratory plasticizer of excellent permanence. It assures freedom from high taste and odor transfer to food from refrigerator gaskets.

In addition, Harflex 330 has good resistance to migration into polystyrene, lacquer and varnish as well as extraction by water, soapy water, oil and gasoline. Its stability under humid conditions is excellent. Tests prove its electrical measurements outstanding and its dielectric strength, both dry and after immersion in water, very high.

You'll find Harflex 330 an all-round efficient plasticizer offering true economy.

Write for Bulletin or Consult Chemical Materials Catalog, Pages 159-161.

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Medium impact ABS resins

A new line of medium impact ABS thermoplastic resins, identified as Cycolon, have been announced by the Marbon Chemical Div., Borg-Warner Corp. Developed to have the general physical properties but not the high impact performance of Marbon's Cycolac brand polymers, the new ABS resins have fast mold cycling and flow, excellent sheet forming, good profile dimensional control and high extrusion rates. Standard, natural or custom colors are available.

Some properties of Cycolon ABS resins are as follows:

Tensile strength, psi 73°F.	7,000
Flexural yield strength, psi. 73°F.	10,500
Flexural modulus, psi, 73°F.	370,000
Rockwell hardness	R-108
Izod impact strength, ft. lb./in. notch, 73°F.	2.0
—40°F.	0.9
Specific gravity	1.04

Suggested uses include refrigerator trays, shelf supports, crispers, etc.; automotive duct work, knobs, grills; toys; phonograph records; housewares; and radio and TV components.

Item 4

Very high-impact acrylic

Implex R, with double the highest impact strength previously available in the Implex high-impact family of acrylic molding powders and available in natural and a wide range of standard colors, has been announced by Rohm & Haas Co. It is translucent with a high degree of transparency in natural color, contains no plasticizers, is dimensionally stable, low in water absorption, resistant to staining and attack by many chemcals, corrosion-free, and free of odor and taste.

Parts molded of Implex R can be cut, drilled, machined, and solvent-cemented. Surfaces can be decorated by most of the usual methods. Molded and extruded panels can be heated and formed into complex shapes by vacuum, air pressure.

The average physical properties of Implex R follow:

Specific gravity	1.08
Tensile strength, psi	5,800
Tensile modulus, psi	270,000
Elongation, %	40
Flexural strength, psi	8,500
Flexural modulus, psi	280,000
Impact strength:	
Charpy, at 73° F., ft./lbs.	62
At —13° F.	36
Izod, ft./lbs./in. notch at 73° F.	4.5
At —13° F.	0.5
Compressive strength, psi	8,000
Compressive modulus, psi	298,000
Rockwell hardness	L-59
Max. rec. continuous service temp., no load, °F.	165–185
Heat distortion temp., °F.:	
At 264 psi.	183
At 66 psi.	196
Flammability, in./min.	1.2
Mold shrinkage, mil/in.	4–8
Flow temp., °F.	290

Typical applications include housings for business machines, appliances, radios, etc., and in automotive, communications, toy and houseware fields. *Item 5*

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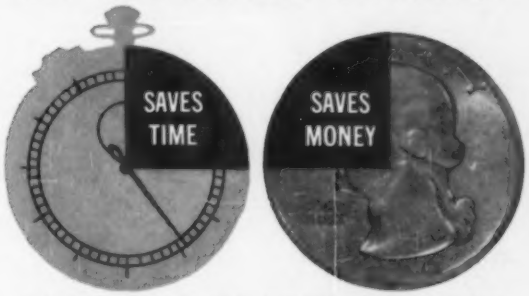

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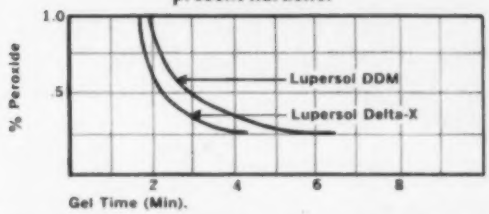

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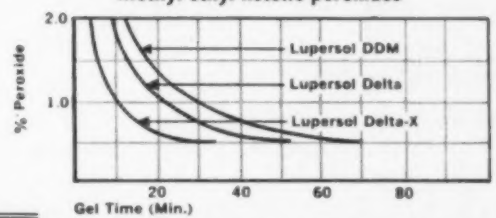

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For more information check Readers' Service Card No. 123

Easily mixed epoxy adhesive

Bondmaster M 666-A/B, a 1:1 (by volume) mix, 100% reactive, modified epoxy, room temperature-curing adhesive for high strength industrial use, has been announced by Rubber & Asbestos Corp. Part A is colored cherry red, and Part B is clear amber; the user mixes the two until a uniform tint is achieved. The simple by volume mixing ratio eliminates the need for scales or elaborate metering equipment. The mixture is free-flowing and may be applied by spatula, paint roller, knife, brush, or standard two-part epoxy spray equipment.

The new adhesive produces high strength bonds between practically any materials including metals, plastics, ceramics, wood, etc. Coated parts may be mated without delay to cure at room temperature and do not require pressure other than that necessary to keep components in intimate contact during cure. All bonding surfaces must be thoroughly cleaned, degreased, and dried.

Bondmaster M 666 unmixed has a storage life of at least six months; the pot life of a one-gallon mixture will be about 1½ hours at room temperature.

At room temperature, assemblies can be handled in approximately 8-14 hours; 85% of maximum strength is developed in 24-48 hours, bond strength continues to increase for about one week. If a faster cure is required, the following schedule is recommended: 120 minutes at 150° F., 45 minutes at 200° F., 30 minutes at 250° F., or 10 minutes at 300° F. (maximum curing temperature). Fully cured metal-to-metal bonds tested at room temperature using MIL-A-5090B procedures, yield up to 3,500 psi. *Item 6*

Versatile epoxy adhesive

A new three-component, thermosetting adhesive called Raiseal 5002 and suitable for bonding stainless steel, aluminum, copper, nylon, polyethylene and polypropylene, has been announced by Radiation Applications, Inc. Component A is a modified epoxy resin which when properly cured produces a highly crosslinked bond. Component B is a high molecular weight flexibilizer, and may be used in varying amounts with component A. Component C is a catalyst.

Raiseal 5002 is expected to have wide application where poor bonding of polyolefins with existing adhesives or where heat-sealing has presented serious drawbacks. It is effective on polyethylene surfaces without pretreatment by flaming, corona or chemical dips. Raiseal 5002 has been used as a rigid adhesive for obtaining high tensile shear values or as a flexibilized adhesive where high peel strengths are necessary. Formula I, given below, is suggested for bonding aluminum, steel and other metals for high tensile shear values and Formula II for high peel strength.

Formula	I	II	Sp. Gr.	Vis.
Part A	100	50	1.03	100-115 cps.
Part B	100	100	1.29	300-400 cps.
Part C	2	1	0.88	—

Pot life 35 min. 1½ hrs.

Some values of tensile shear strength and peel strength obtained after bonding several different materials are listed below:

Material	Cure	Tensile Shear, psi.
Stainless steel*	250° F., 4 hrs.	1750
Aluminum*	250° F., 4 hrs.	1000
Copper foil*	250° F., 4 hrs.	128 (copper foil broke)
Nylon*	250° F., 4 hrs.	400
	250° F., 2 hrs.	192
Polyethylene** (20 Mil)	212° F., 2 hrs.	84
	212° F., 4 hrs.	100

*Using Formula I.
**Using Formula II.

Material	Cure	Peel Strength, lbs./in.
Copper	250° F., 1 hr.	9.5
	250° F., 2 hrs.	13.0
	212° F., 2 hrs.	14.0
Nylon	250° F., 2 hrs.	11.5

In addition to its excellent bond strengths, Raiseal 5002 is resistant to degradation at high temperatures. Bonds with stainless steel exposed to 500°F. for 250 hours had tensile shear values in excess of 250 psi. *Item 7*

PVC packaging film

Resinite VF-70, a new PVC packaging film said to have unusual clarity, brilliant surface, and excellent heat sealability, while being non-fogging and consistent with current Food and Drug Administration regulations, is being produced by the Borden Chemical Co. Some of the properties of this film are given in the table below:

Thickness, in.	0.00075
Specific gravity	1.28
Yield, in.²/lb.	28,700
Tensile, psi, M.D.	3,500
T.D.	2,000
Elongation, %, M.D.	80 min.
T.D.	90 min.
Impact (Falling dart) 23° C.—W.F., gms.	300
Elmendorf tear, gms./mil	40 min.
WVTR, gms./100 sq. in./24 hrs./77° F.	15
Heat seal, 50 psi. ½ sec.	360° F.
Gas transmission, cc./100 sq. in./24 hrs./77° F.: O_2	100
CO_2	345
Flammability	Self-extinguishing
Ink adhesion	Excellent

Additional film types in a wide range of gages will be announced shortly, according to the company. *Item 8*

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CUT DRYING TIME on ALL THERMOPLASTICS

The Only Oven Designed to Dry Nylon to Minimum Moisture Content

Fan speed control. 10KW for fast heat recovery. Totally enclosed heating elements. ½ HP fan motor. Mechanical air-drier five times more efficient than desiccant. Requires NO operator attention.

Tray size: 15″ wide x 30″ long x 2″ deep
Floor space: 5′ 3″ x 30″ deep x 5′ 4″high
Shipped from Stock.....$1885.86

(220 volt, 60 cycle, 3 phase)

ORDER NOW

INJECTION MOLDERS SUPPLY CO. INC.
17601 South Miles Rd. • Cleveland 28, Ohio

For more information check Readers' Service Card No. 124

PE Garment Bag Compounds

Tenite Polyethylene 2901F-Natural, a high-slip formulation, and Tenite Polyethylene 2904F-Natural, an extra-high-slip formulation, expressly compounded for use in garment bag film extrusion, have been announced by Eastman Chemical Products, Inc. Exceptional toughness and clarity are obtained in film extruded from these formulations, according to Eastman.

Both materials are processable at fast production speeds, with very good draw-down characteristics, and uniform film quality. Film can be extruded in thicknesses as low as 0.4 mils without die tear-off. In a 2.5 inch extruder with a 16:1 L/D ratio, 0.4 mil film may be processed at 160 fpm. and 1 mil film at 60 fpm. with cylinder temperatures 270°-310°F., gate, neck, die, and melt temperatures at 310°F., and a screw speed of 40 rpm.

Both 2901 and 2904 have a nominal melt index of 7.0, a density of 0.926, a Vicat softening point of 100°C., and a brittleness temperature of —50°C. Their tensile strength at fracture is 1400 psi. and is 1700 psi. at yield; elongation is 100%; stiffness in flexure, 32000 psi.

Some properties of the film from both 2901 and 2904 are given below:

Film Properties

Property	2901		2904
Thickness, mils	0.4	1.0	1.0
Haze, %	6	8	8
Gloss at 45°, %	55	50	50
Specular transmittance, %	60	40	40
Blocking, gms.			
Natural, 23° C.	0	0	0
Conditioned, 70° C.	60	40	40
Dart impact strength, Gms. at 26 ins.	—	35	35
Coefficient of friction, 10 ft./min.	0.20	0.15	0.10
Min. sealing temp., °F. ½ sec. cycle, 30 psi. jaw press.	250	250	250

Item 9

Heat-resisting epoxy

Thermoset 607, an epoxy resin with heat distortion temperatures above 300°C. (572°F.) and available as a pure resin or in laminating or casting resin versions, has been announced by Thermoset Plastics, Inc. Aromatic amine curing agents, such as Thermoset Hardener #10, may be used with this resin to obtain these high heat-distortion temperatures. Silica- and metal oxide-filled versions of this resin are also available for electrical and tooling uses.

Thermoset 607 has a weight per epoxide of 175-190; viscosity at 25°C. of 10,000-16,000 cps.; specific gravity at 25°C. of 1.15-1.17; and color of 10 max. Cured two hours at 200°F., plus two hours at 300°F., plus six hours at 400°F. with 18 phr Hardener #10, Thermoset 607 gives:

Tensile strength, psi.	9,350
Elongation, %	3.82
Modulus	0.4×10^5
Flexural strength, psi	17,430
Flexural modulus	0.44×10^5
Izod impact strength, ft./lbs.	0.28
Water absorption, %	0.14

Usages foreseen include adhesives, coatings, electrical insulating and plastic tooling, and prototype molds for plastic and rubber parts. *Item 10*

A CONDENSED FACT FILE ON EPOXIES BY FMC

OXIRON EPOXY RESINS 2000, 2001, 2002

These epoxidized polyolefins have multiple epoxy and reactive double bonds as reaction sites—Versatile cure thanks to greater reactivity—Lower density means more volume per pound—Uses include reinforced plastics, adhesives, surface coatings, potting, encapsulating, propellant binder—For the full story send for:

Epoxy Data Booklet

DIEPOXIDES

Dicyclopentadiene Dioxide

This difunctional epoxide can be used both as a modifier for conventional epoxy resins and as a primary building block for epoxy resins—Provides resins with high heat distortion points—Formulations are liquid and have good pot life.

Technical Bulletin No. 95

Limonene Dioxide

A colorless liquid combining the reactivity of an internal and an external epoxy group in the same molecule. Reactive diluent, pleasant odor and ease of handling are characteristics—Resin former-itself.

Technical Bulletin No. 96

OLEFIN OXIDES

Octylene Oxide

Reactive diluent for epoxy resins—Improves low temperature flexibility of bisphenol A-based epoxy resins—Controls exotherm—Copolymerization to give unique polyols for polyurethane manufacture—Pleasant odor, safe handling.

Technical Bulletin No. 71

Dodecene Oxide

Versatile epoxide—Can be used as reactive diluent for epoxy resins to improve low temperature flexibility, intermediate in perfumes, plasticizer, stabilizer for chlorinated products, lubricant additive—Safe handling.

Technical Bulletin No. 73

C16-C18 Olefin Oxide

Mixed epoxidized olefin combining long chain hydrocarbon structure with a reactive epoxy group, stabilizer for chlorinated products.

Technical Bulletin No. 74

ALSO TERPENE OXIDES

Limonene Monoxide

Technical Bulletin No. 81

Alpha-Pinene Oxide

Technical Bulletin No. 82

For additional information on these products write for the bulletins mentioned above —

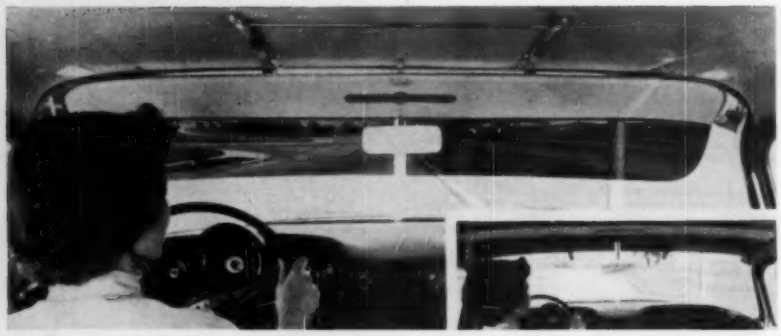
EPOXY DEPARTMENT, FMC CORPORATION

161 East 42nd Street, New York 17, N. Y.

For more information check Readers' Service Card No. 125

Plastic Application

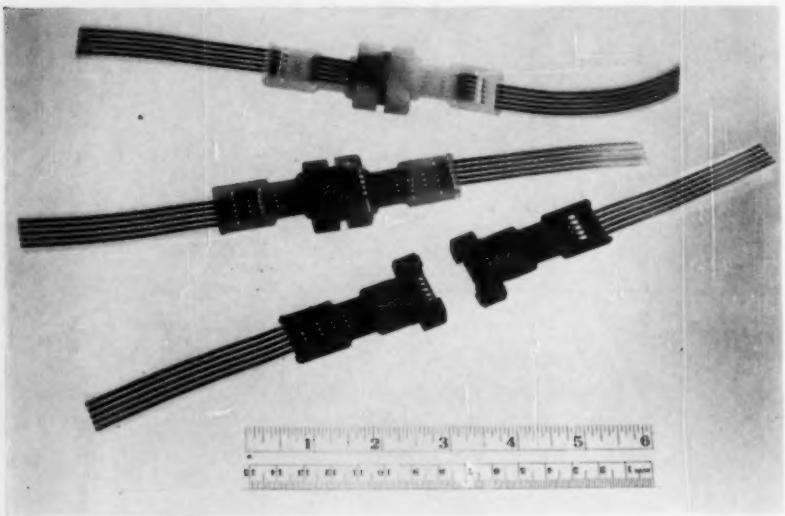
Service Item numbers refer to numbers on Readers' Service Card facing page 78.



Molded acrylic auto sun visor

An automobile sun visor with an opaque, off-white ivory upper half and a transparent anti-glare bluish-green lower half is being produced from Plexiglas acrylic plastic of Rohm & Haas Co. by Evart Products Co. for Vista-Visor, Inc. Measuring 13 by 57 inches and weighing 4½ pounds, the Sunshield is said to be one of the largest plastic parts in terms of either weight or surface area ever injection molded of acrylic resin. A 200-oz. HPM pre-plasticizing machine is used and the molding of the see-through lower half is of optical quality.

In use, the visor slides on stainless steel rails mounted inside the car roof and is adjusted to the desired position by a handle at the top center of the unit. The slotted transparent lower half slides down behind the car mirror and covers the top half of the windshield. The opaque upper half of the visor is then in position to block out the heat and glare of the sun. Stick-slip friction, adjustable by a thumb screw on each rail, between nylon shoes attached to the upper rim of the visor and the stainless steel tracks hold the visor in proper position. *Item 41*



Molded nylon cable connectors

New "Pos-E-Flex" flat conductor cable connectors molded of DuPont's "Zytel" 101 nylon resin by Thomas & Betts Co. are finding increased use in house wiring, communications systems, automotive equipment, appliances, Hi-Fi equipment, and low-voltage controls and instrumentation. These connectors offer a quick and convenient method to interconnect flat conductor cable or to hook up flat cable to conventional cable by means of a round wire adapter.

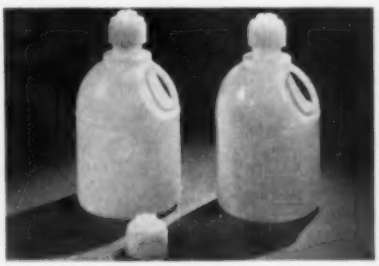
The "Zytel" resin was chosen for the connectors to balance the high dielectric strength and abrasion resistance of cable insulation of "Mylar" polyester film, it is said. Ability of the resin to accept dye after molding proved an additional advantage in color-coded applications. *Item 42*

Well designed 5-gal. PE jugs

Owens Plastics Co. is marketing a new blow molded 5-gallon "jug-shaped" container made from conventional polyethylene that features an extra-strength grip for safe and easy handling. The handle is recessed to permit a form-fitting overpack and is large enough to accommodate man-sized gloved hands.

Outside dimensions of the container are 11 inches in diameter and 19¾ inches in height. The inside neck diameter is 83 mm. Weighing 3¼ pounds, it has an overflow capacity of 5.25 gallons.

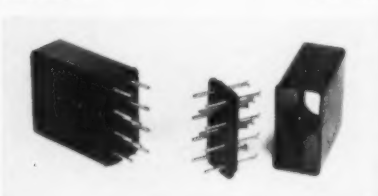
Of conventional polyethylene, these Owens' containers are ICC approved for use with overpack. For use without overpack, ICC approved containers are available in the same dimensions and weight. Also available is a lightweight, two-pound jug of the same capacity made from linear polyethylene. Ultraviolet inhibitors are added to all three models. *Item 43*



All epoxy module packages

Molded, all epoxy module packages (headers and cases) which plug into standard 8 or 10 pin crystal can relay sockets are now available commercially from stock from the Epoxy Products Division, Joseph Waldman & Sons. The cases, which measure 0.4 by 0.8 by 0.844 of an inch high, are open at the top for easy filling in production line applications. A friction fit between header and case prevents liquid epoxy from leaking during encapsulation. Header pins can be either gold plated or tinned copper and are available with a solder well or for wrap around connections.

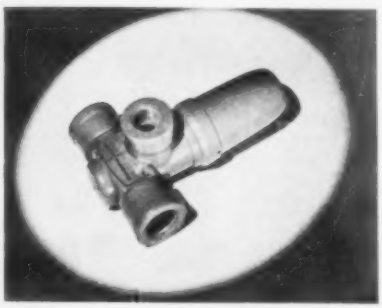
Because both the header and the case are molded of epoxy, the module has excellent electrical and mechanical characteristics and will withstand continuous operating temperatures of 400°F. With an epoxy encapsulant the module will withstand temperature and humidity cycling in accordance with all applicable military specifications. *Item 44*



Molded ABS hydraulic valve

An unusual hydraulic valve, one of the key components in the new, automatic, low-cost Sequa-Matic lawn and garden sprinkling system of the John Bean Division of Food Machinery and Chemical Corp., is made of ABS plastic instead of bronze because of this plastic's excellent dimensional stability, impact, corrosion and weather resistance and superior moldability. Cycolac brand ABS plastic of the Marbon Chemical Division of Borg-Warner Corp. is used.

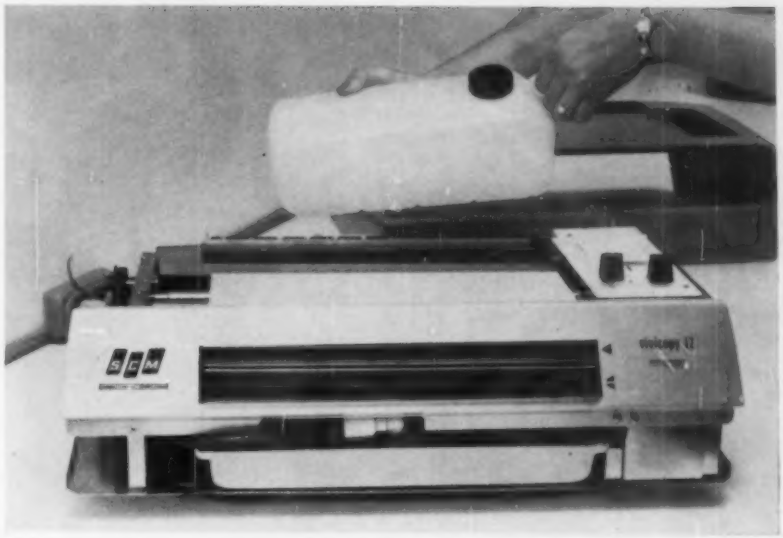
Faster, more efficient, low cost output has been achieved because of the excellent moldability of the Cycolac. The valve comes from the mold with an attractive, glossy surface that does not require painting and with perfectly formed threads which eliminate rejects or extensive finishing operations. In operation, the valve has demonstrated that it is virtually indestructible. *Item 45*



Household iron, teflon shoe

A thin shoe made of DuPont's Teflon plastic designed to slip over the bottom of any standard household iron is called the "Iron Glider" and is a product of Tri-Point Industries. The very low coefficient of friction of Teflon not only makes ironing less tiring, but also eliminates the pick-up of starch or lint, and eliminates of scratching of the sole plate, and removes any doubt about safely ironing miracle fabrics.

Other features of this portable attachment are its ready transfer and control of the heat from the iron to the material being ironed, and the chemical inertness of the Teflon. *Item 46*



PE developer solution container

A blow molded linear polyethylene disposable container is being used in the new Vivicopy 12 automatic photo copy machine by Smith-Corona Marchant to simplify handling of developer solution. Dewitt Plastics makes the 58-ounce cartridge shaped container from Celanese Polymer Company's Fortiflex polyethylene.

The sealed container of developer fluid is inserted in the back of the machine. When the machine is turned on, the fluid is automatically pumped into a tray where the developing process takes place. On completion of the copying cycle, the fluid is returned to the container without unnecessary loss and deterioration due to exposure to the atmosphere. When the machine needs new developer, the old cartridge is removed and thrown away and a new one inserted, thus doing away with pouring, mixing and possible spilling of the developer. *Item 47*

New closures for dispensers

Three new plastic closures by Stull Engraving Co. with double seals, a jet dispenser (1), a squirt dispenser (2) and a "captive connected" spout jet dispenser (3), provide improved sealing of dispenser bottles. These closures use DuPont's "Alathon" 20 polyethylene, which has recently received formal recognition by the Food and Drug Administration as safe for food handling use, to achieve controlled shrinkage, dimensional tolerance, controlled elasticity for snug fit, resistance to stress cracking, the required flexibility, and fast production speeds.

The jet dispenser closure features a large marking or stamping area, dripless dispensing nozzle, insured sealing, and high-speed production design. The squirt dispenser closure has a special "break-off" spout and its dripless dispensing nozzle may be resealed by reinserting the break-off spout as a plug. The "captive connected" spout jet dispenser has a captive spout cap that moves out of the way by free shipping, and its tip opening may be varied in size and direction. *Item 48*

Question:
how to mold
more pieces
in less time
at lower cost?

Answer:
with a RODGERS
Automatic Transfer
and Compression
Molding Press

MORE PLASTIC MOLDED PIECES ...IN LESS TIME ...AT LOWER COST

Check these performance features, available only in RODGERS Molding Presses

1. **FAST CYCLE**... From material to finished parts in 50 seconds (72 grams melamine — 12 cavity mold — machine time 13 seconds).
2. **FLEXIBLE HYDRAULIC CONTROL**... gives precise speed and pressure for set-ups through rapid adjustment of relief valves.
3. **UNLOADER OPERATES AUTOMATICALLY**... operator never has to remove molded parts by hand.
4. **CHANGE-OVER IN SECONDS**... from top to bottom ejection, from transfer to compression, merely by turning a selector switch.
5. **2400 LBS. HOLDING FORCE**... parts held in desired portion of mold through pressure from positive-acting air cylinders. This reduces the number of springs needed, in some operations eliminates springs entirely.
6. **PROFITABLE PRODUCTION** is assured by all of these features, plus easy maintenance, quick accessibility to all components, floor-mounted pumping unit, accurate temperature controls, insulated platens, fully automatic pre-heater, and many other advantages which add up to *greater* production, in *less* time, at *lower* cost.

RODGERS molding presses are available in standard models of 100, 150, 200 and 300 tons. Send print, or part, and production requirements for recommended size, type of press, and accessories, to give you maximum profit.

RODGERS HYDRAULIC PRESSES

RODGERS HYDRAULIC, INC.
Pioneers in high-pressure Hydraulics, since 1932
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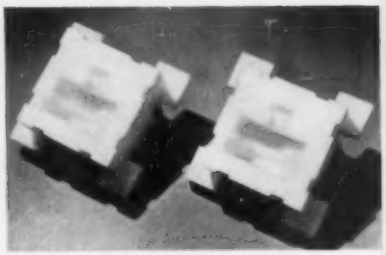
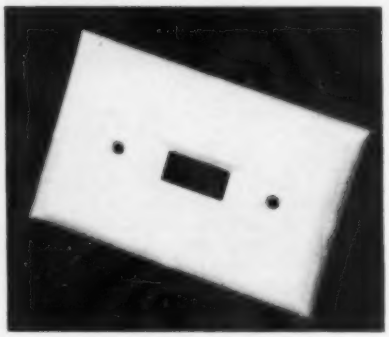


Foam plastic package

An inexpensive, re-useable pack using "Pac-Trim" foamed polyethylene to provide maximum protection of sensitive instruments, devices, components and assemblies against shock damage during shipment, has been announced by Pac-Tron, Inc. The two halves of the pack are sealed with pressure-sensitive tapes and the whole pack can then be shipped in any shipping container. Shock loads are distributed equally to all six sides of the container. Weight of the pack illustrated is approximately eight ounces.

Pac-Trim has a closed-cell construction, is unaffected by temperatures between —65° and +160°F., humidity or altitude; has excellent "memory"; slow-controlled rate of rebound; will not "dust" or deteriorate; can be fabricated in a variety of shapes and sizes to "capture" irregular shapes of any kind; and meets or exceeds Mil. Specs. for packaging. It is light in weight, chemically neutral, resilient, has excellent insulation value, and no odor. *Item 49*



Luminescent light switch plate

A light switch plate which glows green by night to assure quick location and also provides a glare-free radiance in nurseries, passageways, etc., is available from Sylvania Electric Products, Inc., a subsidiary of General Telephone & Electronics Corp. The white pearl tone cover plate, which is made of DuPont's Zytel nylon resin, serves as a diffuser lens for the light which emanates from a 0.2 watt electroluminescent film. Zytel resin was used because of its electrical resistance, ease of cleaning and ease of assembly.

The cover plate is wired directly to terminal posts on single pole switches and attached with screws in the usual manner. The switch plate will remain in continuous day and night operation for at least five years with a yearly cost per plate of 5¢ or less. *Item 50*

Flex it a million times... an

Speaker vents spaced 0.020", molded-in snaps, and thin-section self-hinge on battery door show the molding versatility of AviSun injection grade polypropylene. Custom molded for Motorola by Sinko Manufacturing and Tool Co., Chicago 31, Illinois.

AVISUN

polypropylene self-hinge *won't break!*

Motorola chose AviSun polypropylene for the cases of their transistor radios for these good reasons:

UNIQUE FLEXIBILITY. Self-hinge characteristic is new in the plastics field . . . can be used to cut costs, speed assembly, improve designs on a wide range of cases, boxes, and receptacles.

HEAT RESISTANCE. Polypropylene will not soften or lose strength, even at temperatures close to 220°F.

TOUGHNESS. Has the resiliency to absorb dropping and rough handling without chipping, cracking, or breaking.

ECONOMY. Polypropylene, lightest of all plastics, gives high yield per pound. Takes texture, detail and speaker vents beautifully.

The same advantages that make polypropylene the choice for transistor radio cases can benefit you in *your* product. Call on AviSun for complete data on resin grades —and for expert technical assistance.

AVISUN*

*TRADEMARK OF AVISUN CORP.

Mail coupon for technical information

AVISUN CORPORATION
Dept. 587, 1345 Chestnut St.
Philadelphia 7, Pa.

Send me Booklet AP-601 giving full technical information on AviSun Polypropylene.

NAME_____
(Please Print)

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

In Canada: *Courtaulds Plastics Canada, Ltd.*

For more information check Readers' Service Card No. 127

NEW PACKAGE-PRICE PRESSURE INSTRUMENTS by WEST—for plastic extruders

I-S86 PRESSURE INDICATOR

including choice of transducer for* (Specify)

0-3000
0-5000
0-7500
0-10,000 PSI

$595

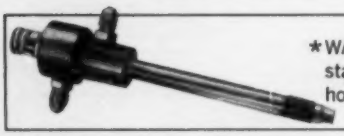
JL-S86 INDICATOR WITH HIGH-PRESSURE ALARM

including choice of transducer for* (Specify)

0-3000
0-5000
0-7500
0-10,000 PSI

$695

- measure direct plastic melt pressures
- warn of screw trouble and clogged screens
- push-button calibration
- no dead weight tester necessary for set-up
- complete with 20-ft.transducer cable
- designed for both lab and production uses



*WATER-COOLED TRANSDUCER fits standard ½"-20 UNF melt thermocouple hole. Stem length 4¾".

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SUBSIDIARY OF GULTON INDUSTRIES, INC.

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Represented in Canada by Davis Automatic Controls, Ltd.

For more information check Readers' Service Card No. 128

Special polypropylene filament

Keystone Plastics, Inc. is extruding a unique monofilament called "Keystrand" from Enjay Chemical Co.'s Escon polypropylene that is said to possess cost and performance advantages over natural fibers, other plastic filaments and steel wire for street sweeper bristles. The new filament is extruded to form a hard outer shell that encases an oriented center fiber which provides higher tensile strength than other synthetic sweeping filaments.

According to Keystone, the tough, yet pliable, inner core imparts strength and smooth-sweeping properties to Keystrand while the hard outer shell gives high abrasion resistanc, rigidity and flex, along with the ideal bend recovery need for heavy sweeping jobs. Keystrand has many times the service life of natural fibers and also compares favorably on an over-all cost per sweeping mile basis with nylon and other synthetic filaments.

Other advantages for the new filament are said to be its unusually close size tolerances; its ability to withstand dry rot; its water resistance; its flexibility; and its light weight. *Item 51*

New vinyl sheeting patterns

Three new patterns of vinyl sheeting for vinyl-to-metal applications are available from the Pennsylvania Div. of General Tire & Rubber Co. Atlantis, Aerofleet, and Twill Boltaflex 500 vinyl sheeting comes in thicknesses from 0.010 to 0.020 of an inch and can be produced in a wide range of widths in almost any color desired. It is recommended for use when a metal product demands a decorative finish and where standard metal finishes give inadequate protection. *Item 52*

PE grass catcher for mowers

A polyethylene grass catcher for its side wheel reel grass mowers is being made by Jacobsen Manufacturing Co.'s plastics division. Thermoformed from Phillips Chemical Co.'s high density Marlex polyethylene sheet, these grass catchers are lightweight, stain resistant, and color fast, and also offer the advantages of toughness, abrasion resistance, and freedom from mildew and rust. *Item 53*

New Literature

Service Item numbers refer to numbers on Readers' Service Card facing page 78

"Radcor Standard Temperature-Rated Electric Infrared Ovens." Catalog BRG-115 Radcor, Inc. 16 pages. The Radcor temperature rating method of selecting the right oven to handle a given heating problem once the maximum temperature and total time have been determined, is described. Typical vertical and horizontal ovens are illustrated. Included is a table of time-temperature relationships for various products, a nomograph for determining oven length and a listing of 540 vertical and 144 horizontal standard model ovens, with dimensions and prices. *Item 61*

"Serv-Rite Insulated Thermocouple Wire, Thermocouple Extension Wire, Multi-pair Extension Cable." Bulletin 1-100. Claud S. Gordon Co. 12 pages. Complete information in text and tables is given on insulation, sizes, dimensions and prices for insulated thermocouple and extension thermocouple wire, and multi-pair extension cable. All thermocouple wire is selected and matched to meet the Standard Limits of Error of Instrument Society of America Recommended Practices, RPI. 3. *Item 62*

"Naugatuck Plastics Resin Guide, 1961-1962." United States Rubber Co., Naugatuck Chemical Div. 16 pages. The properties, special features and applications of Vibrin polyester resins, Kralastic ABS resins, and Marvinol vinyl resins, together with Marvibond vinyl-to-metal laminates, are covered. Charts detail the properties, features and applications and many of the latter are also illustrated. *Item 63*

"Cadco Nylon Rod, Plate, Strip, Tubing, Molded Shapes." Cadillac Plastic and Chemical Co. 8 pages. Data on the range of available shapes, sizes and properties includes "6" and "101" types of nylon. Physical properties on four available grades Cadco nylon are also given. Data on moisture conditioning, machining, bonding, welding and coloring of nylon parts is also included. *Item 64*

"Gantrez AN . . . Poly(Methyl Vinyl Ether/Maleic Anhydride)." General Aniline & Film Corp., Commercial Development Dept. 40 pages. Physical, chemical and physiological properties of Gantrez AN in its three currently available molecular weights are covered. Applications are cited in 19 industrial fields including textiles, adhesives and coatings, paper, plastics, etc., for this water-soluble polyelectrolyte. Numerous tables and charts are included in the description of physical and chemical properties and applications. Tack-free dry films with high cohesive strength that form strong bonds with glass, plastics, metal, cellulose, etc., are obtained with Gantrez AN. A bibliography is included. *Item 65*

"Rod & Sheet Stock." "Adjusted & Artificial Dielectric Constant Foams." "Standard Foams." Multi-colored charts. Emerson & Cumming, Inc. A great variety of information is shown on these multi-colored charts for rod and sheet from standard polystyrene, fluorocarbons, epoxies, etc. with physical and electrical properties plotted; for adjusted and artificial foams of polyurethane, silica, polystyrene, epoxy, etc.; and for standard foams of previously mentioned materials and phenolics. Many photographs of end products are included with each chart. *Item 66*

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FLIGHTEX GLASS CLOTH AND TAPES

- Highest standards of quality
- Uniformity of weight, weave and thickness
- Maximum strength of reinforcement

If you're out to win lower production costs, or higher quality of performance — if you want maximum efficiency in your glass cloth needs, FLIGHTEX may be able to assist. Our research laboratories and development facilities are ready to help find the exact fabrics to meet your particular needs.

Write for our Specification Guide.

FLIGHTEX FABRICS INC.

93 Worth Street • New York 13, N. Y.

Check Readers' Service Card No. 129

RESIN METERING, MIXING AND DISPENSING PROBLEMS CAN BE...

... as difficult as doing a Ballet in a Telephone Booth

BUT NOT FOR APC... Here's Proof...

There's an APC machine for many multi-component resin metering, mixing and dispensing problems. Automatic Process Control devotes 100% of their design and manufacturing skills to this field.

See the results of this specialization — APC's fine new family of dependable and efficient machines.

Write for literature and price information.

MODULAR MARK IV HYDROSPENSER

Latest version of dependable Mark IV standard shot machine with increased flexibility. Handles high temperature, highly filled resin systems. From 5 to 750 cc's.

MICRO-SHOT HYDROSPENSER

Accurate small shot metering, mixing and dispensing for miniature component encapsulation, sealing, impregnation, etc. From a fraction to 20 cc's.

ON-THE-FLY DEGASSER

Self contained unit for degassing liquids and hot melts used in producing castings free from voids caused by entrapped gases.

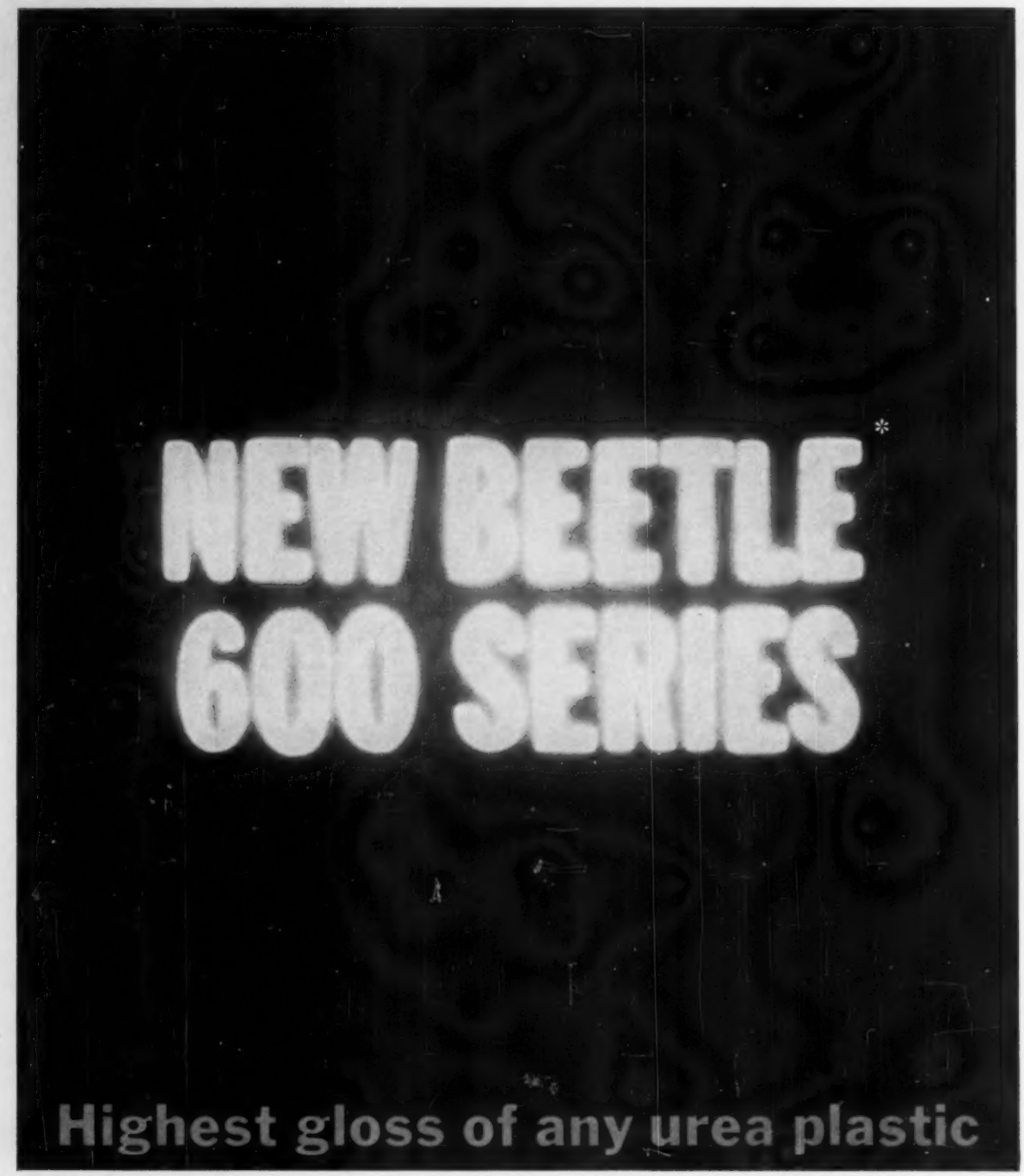
HYDRO VAC

Versatile, self contained unit with integrated controls — degasses, mixes and vacuum casts multiple component resins, for laboratory or short run production.

AUTOMATIC PROCESS CONTROL, INC.

1123 Morris Ave. • Union, New Jersey • MUrdock 8-1618

Check Readers' Service Card No. 130



Now, make your urea moldings come alive with an unmatched surface brilliance—without sacrificing quality or economy. Three new high gloss formulations make this possible: Beetle 650, designed for small parts such as closures and buttons; Beetle 625, for closures, switch plates, wiring devices and small housings; Beetle 600, for large housings and other parts requiring extended flow. These new Beetle molding compounds cure faster, and they offer improved preforming qualities. And you still have all of these dependable Beetle properties: resistance to detergents, oils and grease; arc-resistance; track resistance; good dielectric strength; surface hardness; stain-resistance; wear-resistance; unlimited range of colors. Be among the first to take advantage of this bright new development. Write for complete information today. *BEETLE – registered trademark for Cyanamid's urea-formaldehyde molding compound.

AMERICAN CYANAMID COMPANY CYANAMID PLASTICS AND RESINS DIVISION

WALLINGFORD, CONNECTICUT. *OFFICES IN:* BOSTON • CHARLOTTE • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DETROIT • LOS ANGELES MINNEAPOLIS • NEW YORK • OAKLAND • PHILADELPHIA • ST. LOUIS • SEATTLE • *IN CANADA:* CYANAMID OF CANADA LIMITED, MONTREAL • TORONTO

For more information check Readers' Service Card No. 131

Book Reviews

POLYMERIC MATERIALS. Charles C. Winding and Gordon D. Hiatt. McGraw-Hill. $12.

The authors of this text have recognized the difficult problem in keeping up with the rapidly expanding field of polymer chemistry. The combination of academic and industrial backgrounds represented by the authors has resulted in a work which although mentioning some of the more recent developments is still emphasized as an "introduction to the field of polymeric materials."

A considerable part of the manuscript was used as the basis for introductory courses in polymer chemistry. Consequently, in spite of the title which implies that the book is wholly devoted to descriptions of polymeric materials, the first part covers some fundamentals of polymer chemistry including polymer structure and the nature of polymerization reactions as well as solubility and molecular weight aspects peculiar to polymers. A discussion of the properties of plastics is followed by what is termed "general applications of polymeric materials" but which actually includes a description of numerous fabrication techniques as related to particular applications. The remaining 60% of the book is devoted to descriptions of polymeric products which for the most part become of commercial significance. A great number of flow sheets graphically illustrate the manufacturing processes used in the preparation of commercial polymers.

The book fulfills the authors' objectives of presenting an overall picture of the field of commercially important polymeric materials. The sections devoted to fabrication techniques should be of interest to the polymer chemist needing an insight, although not a thorough knowledge, of the engineering aspects while the fundamental and descriptive sections should be valuable to the engineer. NORMAN G. GAYLORD

MANIPULATION OF THERMOPLASTIC SHEET, ROD & TUBE. J. M. J. Estevez and D. C. Powell. Interscience Publishers, Inc., $4.85.

The third in a series of monographs primarily intended to cover the syllabus in technology, chemistry, physics and engineering of plastics leading to the Diploma, Graduateship and Associateship of the Plastics Institute (England), about half the book deals with the shaping of thermoplastic sheet. The remainder covers such fabrication methods as machining, decoration, and joining by cementing and welding. There are also chapters on tool construction and design and on special topics, the latter dealing with such things as plastic-metal laminates and biaxial stretching.

The introductory chapter gives the properties and some information on the manufacture of the materials covered, polymeth methacrylate; polyvinyl chloride and vinyl copolymers (rigid PVC); polystyrene and impact polystyrenes; and polyethylenes, into sheets, rods and tubes. In almost all instances, forming techniques for each of these materials are described.

A discussion of machining processes is followed by information on such decorating techniques as stamping, printing, and metallizing. Joining by cementing and welding includes recommendations specific to each of the individual materials.

In the main body of the book, dealing with shaping thermoplastic sheet, materials are divided into those requiring oven preheating and those suitable for use on vacuum forming machines without oven heating. Chapters are then presented on simple shaping with heat, the use of air pressure and vacuum, the use of mechanically applied pressure, and complex processes using a plurality of methods. The vacuum forming machine is the subject of a separate chapter, including comments on its advantages and disadvantages.

In the final chapter, the authors emphasize that the time factor in shaping must be reduced to provide more competition with injection molding, despite the much lower tool costs for shaping.

SOURCE OF THE NEW PLASTICS—VOLUME 2. Herbert R. Simonds. Reinhold Publishing Corp. $8.95.

This addition to the Source Book series covers new materials and processes in the plastics industry through most of 1960. New features include a chapter on technical progress in which stereospecific catalysts, block and graft polymers, fluorocarbon nomenclature, Montecatini developments, and progress in urethane foam are discussed, and a chapter on new processes and applications.

Federal-sponsored research in plastics for the period 1959 to July, 1960, is reviewed by James Kanegis, U.S. Department of Commerce. A few of the most important government-owned patents in plastics during this period are listed.

The main body of the book consists of information on producers' new materials with 69 companies submitting articles on their new products. A survey and review of these new materials in a separate chapter, points out that more activity occurred in the epoxy field than in any other branch of plastics. Activity in polyesters ran second.

Prominence is given to the fluidized-bed process of coating, one-shot foaming of polyether-isocyanate reaction products, and polypropylene extrusion in the chapter on new applications and processes.

Well organized and amply illustrated with photographs, tables and graphs, this newest addition to the series provides practical information on the latest developments in plastics and related materials.

Check Readers' Service Item No. 132

People

Management

William C. Leingang, general manager of Stokes Molded Products Division, Electric Storage Co., has retired and will be succeeded by **Robert Kent.** Mr. Leingang served the company for 38 years, becoming assistant to the president in 1955 and general manager in 1957. Mr. Kent, who joined the company in 1949, has been plant superintendent, manufacturing manager, and assistant general manager.

Donald A. Bullard has been elected a vice president of Northwest Plastics of Carolina, Inc. He has been associated with the company for 20 years and prior to his election was general manager of the Gastonia, N. C. plant.

A. O. Redland has been elected chairman of the board of Vulcanized Rubber and Plastics Co. He will also continue as president and general manager. **William F. Heefner** of the law firm of Curtin and Heefner and a director of Vulcanized Rubber and Plastics, has been named vice president. **Robert J. Dobuski** has been elected to the board of directors and appointed production manager of both the Rubber and Plastics Divisions.

Stanley J. Trykowski has been appointed technical director and **Sumner Levin** as manager of plant operations of the Blane Corp., manufacturer of vinyl and polyethylene compounds and color concentrates.

John Gordon Davoud has been named executive vice president of the Firestone Plastics Co. and Firestone Synthetic Fibers Co. Dr. Davoud has been president of two subsidiaries of Courtaulds, Ltd., the Courtaulds (Canada), Ltd., and a director of Courtaulds (North America), Inc., prior to joining Firestone in September.

N. D. MacKay has joined Thor Corp. as manager of injection molding. He was formerly associated with the Stanley Corp. as technical sales representative.

Amos A. Ball has been appointed assistant superintendent, Plastics Division, American Sisalkraft Co., a Division of St. Regis Paper Co. **Kenneth Klein** has been named market research manager and **James Olsen, Jr.,** manager of metal packaging sales.

Marvin L. Shelton has become vice president and general manager of Loma Industries, Fort Worth, Tex., an industry leader in plastics design, engineering, packaging and custom molding. Mr. Shelton will continue as president of Southwestern Container Corp., an affiliate of Loma Industries, and serve as operational head of Loma's custom packaging, proprietary and housewares divisions.

C. Gordon Jelliffe, president of Columbus Coated Fabrics Co., has been named a vice president of the Borden Chemical Co., of which Columbus Coated Fabrics is a division.

Sales

Walter A. Williams will head the sales of Dyna-Therm high temperature coatings for the company. **Kenneth G. Granger,** formerly manager, eastern contracts department, will be in charge of sales of the company's transparent plastics products.

Charles M. Phinny will manage sales of the reinforced plastics and high temperature coatings divisions of Swedlow Inc. He was formerly manager of the western contracts department.

Harry B. Beisswenger has been appointed district sales manager for Hull Corp. machinery manufacturers, for the Metropolitan New York, Long Island, and Northern New Jersey areas, with offices in Demarest, N.J. Besswenger replaces **Lawrence J. Plummer,** former district manager, who has been made sales manager, Standard Press Div., and is now located at the main factory in Hatboro, Penna.

Robert A. Miller has been appointed sales manager for the specialty plastic films "Aclar" and "Capran" being introduced by Allied Chemical Corporation's General Chemical Div. **Dr. Reginald F. Webb** has been named director of research, Plastics Div., Allied Chemical Corp., with headquarters at the company's research center in Morris Township, N.J.

William R. Browne has been assigned sales responsibility for glass fiber textile products in the New York City area for Johns-Manville Sales Corp., with headquarters at 270 Madison Ave.

William J. Barnett has been named sales manager, pigments, with headquarters at the Adrian Joyce Works, Baltimore, Md., and **John Owen Jones** has been named product manager, colors, with headquarters at the St. Helena Works, Baltimore, of the Glidden Company's Chemicals Division, Pigment and Color Dept.

Ed Whalen has joined Industrial Plastic & Engineering Co. sales force for the New Jersey, Westchester and Long Island areas. Mr. Whalen was formerly N.J. district manager for the Richardson Co.

William A. Drisler, Jr., former Burlington Industries, Inc. executive, has been named vice president-marketing, for a new consumer products marketing organization of the B. F. Goodrich Co., with headquarters at 300 Park Avenue, New York. **James C. Richards,** formerly vice-president-sales of Goodrich's Industrial Products division, heads a newly consolidated industrial products marketing organization as vice president-marketing, industrial products.

Robert M. Simpson has joined Ram Chemicals Manufacturing Co., Inc., Gardena, Calif., as marketing and sales manager for the firm's mold release agents, gel coats, pigments, finishes, catalysts, and other specialty chemicals. Mr. Simpson was formerly manager, pigment sales, Columbia-Southern Chemical Corp., a division of Pittsburgh Glass Co. **Bill O. Blackburn** has been named chief chemist for Garan Laboratories and affiliated Ram Chemical organizations. Mr. Blackburn had been with Shell Chemical Co.

Technical

R. M. Maybee has been named manager of Plastics Technical Service at the Union, N.J., laboratory of Shell Chemical Co. He will be assisted by **V. O. DeCoster** as supervisor technical service, olefins, and **P. M. Ciofalo** as supervisor technical service, polystyrene. **R. E. Brown** has been appointed technical service supervisor, resins, and **F. T. Watson** a senior technologist. The following men have been appointed supervisors of district sales, resins: **P. H. Teliha,** Central (Chicago) District; **R. M. Seppala,** East Central (Cleveland) District; and **F. W. Breslin,** Eastern (New York) District. **R. S. Davis,** a technical salesman in the Central District has joined the head office sales development resins product group as a technologist.

Dr. Charles A. Murray has joined Cordo Chemical Corp. on a full-time basis as director of research, thermosetting plastics, and will headquarter at newly equipped laboratories of the company's Mobile Plastics Div., Mobile, Ala.

John O. Converse has been named director of mechanical research and development of G. T. Schjeldahl Co., Northfield, Minn., where he will concentrate on plastic packaging machinery. Mr. Converse was formerly head of the mechanical engineering research department of General Mills.

Article Abstracts

Materials

"A Survey of Material Developments in Styrenes," G. B. Thayer, PLASTICS AUSTRALIA, 12, 8, 19 (Aug. 1961).
Survey of developments in polystyrenes and styrene copolymers.

"The Epoxy Resins," J. R. Gray, PROGRESSIVE PLASTICS, pg. 63 (Sept. 1961).
A technical review of materials and properties.

"Melt Flow Indexing of Polypropylene," R. V. Charley, BRIT. PLASTICS, 34, 9, 476 (Sept. 1961).
Description of methods and procedures for determining melt index.

"Short Term Stress Relaxation Studies at Low Initial Strain Rates," G. C. Karas, BRIT. PLASTICS, 34, 9, 485 (Sept. 1961).
Discussion of results obtained with different plastics.

"Testing for Electrolytic Corrosion Liability of Electric Insulation," A. G. Day, BRIT. PLASTICS, 34, 9, 491 (Sept. 1961).
A direct method for assessing corrosion liability is described.

"The Effects of Fibre Metal Fillers on the Physical Properties of Epoxy Resin Systems," D. Akins, R. Forester, and F. Holtby, RUBBER & PLASTICS AGE, 42, 9, 1086 (Sept. 1961).
Test results show that resin systems for metal forming tools need the highest possible HDT and physical properties.

"Polypropylene Part II—Features of Application Technology," B. S. Dyer and G. Campbell, PLASTICS (LONDON), 26, 286, 107 (Aug. 1961).
This conclusion of a two-part article deals with effects of processing conditions and their effects on physical properties; hence, applications.

"The Effect of Some Extrusion Variables on Surface Finish," S. J. Skinner and S. D. Eagleton, PLASTICS (LONDON) 26, 286, 113 (Aug. 1961).
A discussion based on rheological considerations.

"Machining Cast Epoxide Products," K. F. Thomson, PLASTICS (LONDON), 26, 287, 79 (Sept. 1961).
A brief note on machining techniques.

"Unsaturated Polyester Resins for Non-Reinforced Panels," G. Muller, PLASTICS (LONDON), 26, 287, 82 (Sept. 1961).
Brief note on the resins and their use in casting onto panels.

"Measurements of the Injection Molding Cycle," J. Leeuwerik, PLASTICS (LONDON), 26, 287, 98 (Sept. 1961).
Discussion of temperature measurements during injection.

"Manufacturing Phenolic Molding Materials," S. A. Ede, PLASTICS (LONDON), 26, 287, 122 (Sept. 1961).
Role of the control laboratory in phenolic manufacture.

"A New Technique of Testing Resin/Glass Laminates," K. J. Brookfield, D. Pickthall, and R. S. Warnurton, PLASTICS (LONDON), 26, 287, 149 (Sept. 1961).
A paper originally presented at the 1961 SPI Reinforced Plastics Division meeting.

"Coatings for Oriented Polystyrene Films," H. A. Scopp, PLASTICS WORLD, 19, 9, 35 (Sept. 1961).
Coating values and their problems are discussed briefly.

"Ignition Temperatures of Plastics," G. A. Patten, MODERN PLASTICS, 38, 11, 119 (July 1961).
Description and test results obtained with a hot-air ignition furnace.

"Cast Flexible Urethane Polymers," C. H. Smith and C. A. Peterson, MODERN PLASTICS, 38, 11, 125 (July 1961).
Physical and electrical properties of polyester-based cast urethane polymers are given.

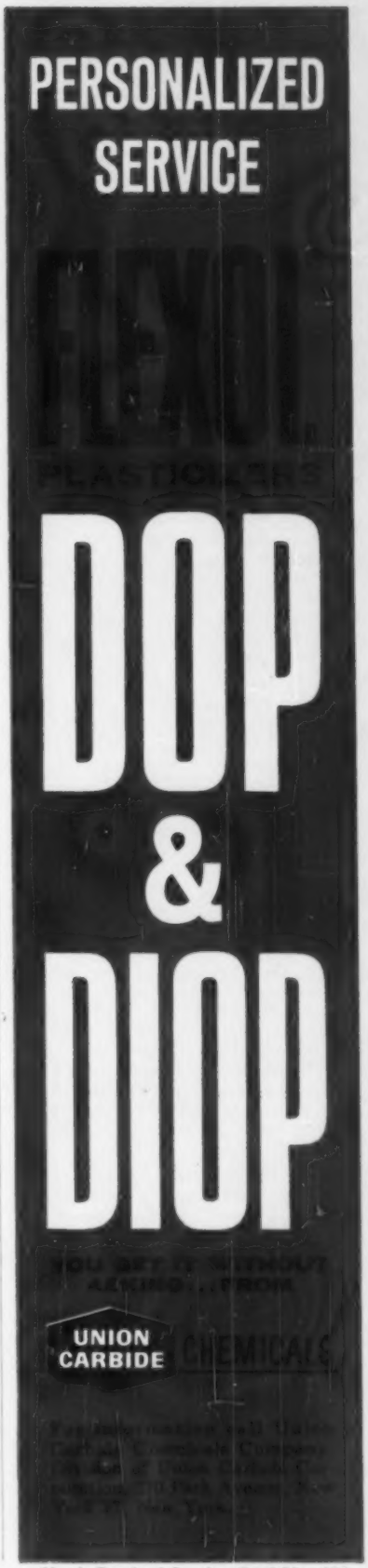
"Straining Behavior of Cellulose Acetate Plastics," K. Ito, MODERN PLASTICS, 38, 11, 129 (July 1961).
Subject strain characteristics are discussed and related to relaxation spectra.

"Material Performance in Impact Molding," Larry Spiwak, PLASTICS WORLD, 19, 7, 20 (July 1961).
Details of behavior and preforming conditions are summarized.

"The Effects of High Vacuum and Ultraviolet Radiation on Reinforced Plastics," N. E. Wahl, SPE J., 17, 8, 759 (Aug. 1961).
Results are given of tests on glass fiber laminates under high altitudes.

"Laboratory Processing Studies of Polyethylene, Polypropylene and Nylon 6 Coatings," J. F. Morris, SPE J., 17, 8, 762 (Aug. 1961).
Comprehensive evaluation and comparison of subject coatings.

"Hydraulic Fluids, Fact and Fancy," G. R. Arbocus, SPE J., 17, 8, 767 (Aug. 1961). A review of the properties of hydraulic fluids.



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"Investigations on Stress Cracking in Low-Pressure Polyethylene," H. Doll and O. Plajer, KUNSTSTOFFE, 51, 7, 358 (July 1961).

Stress cracking at constant stress was investigated, using specimens cut from finished goods.

"Behavior of Glass Fibre Reinforced Molding Materials under Prolonged Stress," H. Wallhaufer and H. Huff, KUNSTSTOFFE, 51, 7, 363 (July 1961).

Examples show how improvements can be made possible, and how various factors influence behavior properties.

"Notes on the Classification of Macromolecular Materials," O. Leuchs, KUNSTSTOFFE, 51, 7, 367 (July 1961).

Suggestions are given for achieving standardization of molecular classifications.

"Detection of Faults in Glass Fibre Reinforced Polyesters, Using Coloration Methods," B. Alt, KUNSTSTOFFE, 51, 7, 397 (July 1961).

Coloration is shown to permit detection of delamination, insufficient bonding and other faults.

"Flow Properties of PVC Gramophone Record Compounds," Per Rangnes, KUNSTSTOFFE, 51, 8, 428 (Aug. 1961).

Results are given for a Macklow-Smith plastometer used in tests.

"Determination of Impact Strength of PVC Pipes," K. Richard, E. Gaube, and G. Diedrich, KUNSTSTOFFE, 51, 8, 431 (Aug. 1961).

Two test methods are described and evaluated.

"The Flow Behaviour of Phenoplastics," D. Northmann and G. Meyer, PLASTE U. KAUTSCHUK, 8, 3, 115 (Mar. 1961).

A historical review and a discussion of flow test characteristics are followed by a report on experiences and results obtained with continuous time/flow measurements. (In German.)

"Using Waste Material from the Production of Articles made from Amino and Phenolic Plastics," M. L. Morgulis and N. N. Senatskii, SOVIET PLASTICS, No. 7, pg. 46 (July 1961).

Methods for grinding these wastes are given.

"Mechanical Testing of Plastics. 1. Physical Basis of the Mechanical Properties of Polymers," S. B. Ratner, SOVIET PLASTICS, No. 7, pg. 58 (July 1961).

A theoretical basis for polymeric mechanical properties.

"Polyolefins in Packaging, with Special Reference to Deep Drawing," G. Muller, KUNSTSTOFFE, 51, 6, 326 (June 1961).

Practical aspects of polyolefin films for packaging are discussed.

"Molecular Orientation and Properties of Plastics Materials," R. Reichberger, KUNSTSTOFF-RUNDSCHAU, 8, 3, 105 (Mar. 1961).

Tests on injection-molded rods of polystyrene, polyethylene and methyl methacrylate show the effect of processing conditions on the degree of crystallinity and/or molecule orientation, and consequently on tensile, bending, and impact values. (In German.)

"New Knowledge of Polycarbonates," H. Streib, GUMMI U. ASBEST, 14, 4, 304 (April 1961).

The author discusses the properties of Makrolon on the basis of further experiences and gives examples of recent applications. He offers hints on processing and finishing, as well as after-treatment to relieve stresses in finished goods. (In German.)

"Plasticizers for PVC. Properties of Linear Tetraesters," E. Nejedly and J. Gottweis, PLASTE U. KAUTSCHUK, 8, 3, 125 (Mar. 1961).

To evaluate saturated linear tetraesters as plasticizers for PVC, the solubility and stability of polyester/plasticizer systems were tested. (In German.)

"The Fundamental Problem of Samples in Testing Plastics," M. A. Dobraczynski, IND. PLASTIQUES MOD., 13, 1, 42; 13, 2, 37; 13, 3, 37, (Jan., Feb.-Mar., & April 1961).

In this Polish study the author examines the effects of different methods of preparing samples on the results obtained. (In French.)

"Thermoformable Paper-Plastics Laminates," V. R. Piper, PLASTICS WORLD, 18, 11, 22 (Nov. 1960).

It is shown that the combination of stretchable kraft paper and plastics film gives a material having the advantages of both.

"Stress Relaxation and Creep Measurements of Some Thermoplastic Materials," R. L. Bergen, Jr., and W. E. Wolstenholme, SPE J., 16, 11, 1235 (Nov. 1960).

It is shown that short-term, high-temperature tests on ABS, vinyl chloride, and methyl methacrylate polymers can predict their long-term, room-temperature performances.

"The Effect of an Amine Cured Epoxy Resin on the Stability of Trinitrotoluene," H. C. Anderson, SPE J., 16, 11, 1241 (Nov. 1960).

Cure mechanisms are discussed for four different curing agents.

"Quality Control Check-list and Procedures for Fluorocarbon Resins," P. E. Thomas, SPE J., 16, 11, 1248 (Nov. 1960).

Procedures for testing TFE and FEP fluorocarbon resins are given, together with factors to consider when testing shapes.

"Flame Retardant Coatings for Plastics," B. J. Tyler, MATERIALS DESIGN ENG., 22, 5, 16 (Nov. 1960).

Intumescent coatings can be applied to electrical parts needing flame retardancy.

"Ethylene," F. J. Mateo and J. L. Mateo, REV. PLASTICOS, 12, 67, 2 (Jan.-Feb., 1961).

A brief review of the petrochemical industry is followed by details on the basic materials from which ethylene is produced, the processes employed, and products obtained. (In Spanish.)

"Flame Resistance of Plasticized PVC Containing Antimony Oxide," J. S. Luna, REV. PLASTICOS, 12, 67, 16 (Jan.-Feb., 1961).

The tests described show the value of antimony oxide in making PVC compounds flame-resistant.

"Investigation on the Behavior of Glass-reinforced Plastics Exposed to Attacks by Marine Flora, and of Teredos in Particular," E. Mor, POLIPLASTI, 9, 44, 49 (Jan.-Feb., 1961).

Results of a nine-month test of panels of glass-reinforced polyester resin covering the keel of a moored boat perfectly resisted attacks of teredos. Other marine growths did develop on these panels, but were easily removed. (In Italian.)

"Problems in Evaluating and Testing Plastics," J. H. Lieb, MATERIALS DESIGN ENG., 54, 1, 115 (July 1961).

Ultra-low temperature testing is discussed in terms of equipment, procedure, and evaluation of results.

"Relaxation of Thermal Stresses in Ziegler Polyethylene," F. Linhardt, KUNSTSTOFFE, 51, 6, 310 (June 1961).

An explanation of the processes involved in the formation of thermal stresses in visco-elastic materials.

"Determination of Sulphate Ash and Lead Content of Lead Stabilized PVC," W. Meyer, KUNSTSTOFFE, 51, 6, 312 (June 1961).

Because of insufficient reliability of the sulphate determination method, a process is suggested for decomposing PVC compounds.

"The Identification of High Polymers by Gas Chromatography. Part II. Identification of Elastomers," J. Voigh, KUNSTSTOFFE, 51, 6, 314 (June 1961).

A report on the examination of chromatograms of major high polymers, with suggestions of their use.

"Injection Molding and Applications of Delrin Acetal Resin," W. R. Reinbacher, KUNSTSTOFFE, 51, 6, 321 (June 1961).

The injection molding of Delrin is discussed.

"The Behavior of Bacteria Mixtures Towards Polyethylene of Different Molecular Weights," Lu Jen-hao and A. Schwartz. KUNSTSTOFFE, 51, 6, 317 (June 1961).

Report on investigations of the relationship of molecular weight and susceptibility of polyethylene to bacterial attack.

"H.F. Pre-Heating of Molding Compounds," H. Wiegand and H. Wallhaufer, KUNSTSTOFFE, 51, 6, 332 (June 1961).

The effects of different types of pretreatment on the dipole properties of the molding compounds are discussed.

"The Electrical Properties of Polymeric Power-Cable Dielectrics," N. Parkman, TRANS. PLASTICS INST., 29, 87, 73 (June 1961).

A report on technological difficulties and problems.

"Stabilization of Plastic Insulating Materials for Wire and Cable," W. L. Hawkins and F. H. Winslow, TRANS. PLASTICS INST., 29, 87, 82 (June 1961).

A discussion of stabilization mechanisms.

"Irradiation of Polymeric Materials," R. M. Black, TRANS. PLASTICS INST., 29, 87, 98 (June 1961).

Radiation processing is discussed and evaluated.

"Newer Ways of Making Polymers—A Guide for the Non-Chemist," M. Kaufman, TRANS. PLASTICS INST., 29, 87, J59 (June 1961).

Transcript of a lecture given on January 17, 1961.

"A Study of Curl in Decorative Laminates," W. E. Morris and J. M. Verdi, APPLIED PLASTICS, 4, 7, 24 (July 1961).

Problems in warping of high-pressure laminates are discussed with reference to processing and environmental factors.

"Nylex Linear Polyethylene Sheet," B. H. Coulls, PLASTICS AUSTRALIA, 12, 6, 25 (June 1961).

Description of a new thermoplastic sheet material.

"Certain Thermal Properties of Polypropylene," I. M. Tolchinskii, N. A. Nechitailo and A. V. Topchiev, SOVIET PLASTICS, No. 7, pg. 6 (July 1961).

Temperature ranges of the melting and crystallization of polypropylene are determined and discussed.

"Stabilizing Polyolefins Against Breakdown by Heat, Light and Oxygen," P. I. Levin, SOVIET PLASTICS, No. 7, pg. 11 (July 1961).

A review of the literature on inhibiting action of oxidation of hydrocarbons.

"The Thermal Breakdown of Hardened Epoxy Resins," M. B. Neiman, B. M. Kocarskaya, I. J. Levantovskaya, A. S. Strizhkova and M. S. Akutin, SOVIET PLASTICS, No. 7, pg. 18 (July 1961).

A comprehensive explanation of thermal breakdown.

"Thermal Properties of Reinforced Plastics," P. T. Howse, Jr. and C. D. Pears, MODERN PLASTICS, 39, 1, 140 (Sept. 1961).

Specific heats, thermal expansion, and thermal conductivities were determined for 12 different resin-reinforcement combinations.

"Hardening of Polyamide Resins," S. M. Raitburd, L. Rodivilova, K. N. Viasova, A. N. Shavadash and A. A. Igonin, SOVIET PLASTICS, No. 7, pg. 22 (July 1961).

The hardening of methylolpolyamides with various alcohol radicals is studied by infra-red spectroscopy.

"Polymers with Inorganic Main Molecular Chains," K. A. Andrianov, SOVIET PLASTICS, No. 7, pg. 25 (July 1961).

Experimental data is reviewed on synthesis of subject polymers.

"Effect of Chemical Treatment of the Surface of Glass Fibre Fabric on the Properties of Fibreglass Laminates," Y. D. Avrasin, A. Y. Korolev, Y. A. Mindlin, A. V. Drogaleva, and A. I. Prigoreva, SOVIET PLASTICS, No. 7, pg. 33 (July 1961).

A study on the effects of chemical treatment of the surface of non-alkaline glass-fibre fabric.

"The Use of Epoxy Compounds as Stabilizers for PVC. 1. The Stabilizing Action of Epoxy Resins," A. S. Danyushevskii and Z. N. Frolova, SOVIET PLASTICS, No. 7, pg. 43 (July 1961).

Some epoxy resins are shown to be very suitable for stabilizing PVC.

"A Study of Maleate and Fumarate Polyester Resins," R. E. Park, R. M. Johnston, A. D. Jesensky, & R. D. Cather, SPE J., 17, 10, 1088 (Oct. 1961).

Data is presented showing that maleates retard cure rates in polyesters.

"Diallyl Phthalate Monomer," Gene Nowlin & L. S. Burnett, SPE J., 17, 10, 1093 (Oct. 1961).

Review of properties, applications, and potential uses for DAP resins.

"Synthesis of Acenaphthylene, its Polymers and Copolymers with Other Monomers," A. V. Golubeva, O. M. Neimark, N. F. Usmanova, K. A. Sivograkova, G. L. Bezborodko, & A. A. Meerson, SOVIET PLASTICS, No. 8, P. 6 (August 1961).

Methods for preparing acenaphthylene are reviewed.

"Silanols and their Conversions. I. Diphenylsilanediol and its Conversion," S. M. Zhivukhin & E. D. Dudikova, SOVIET PLASTICS, No. 8, p. 22 (August 1961).

Methods for preparation of diphenylsilanediol are discussed.

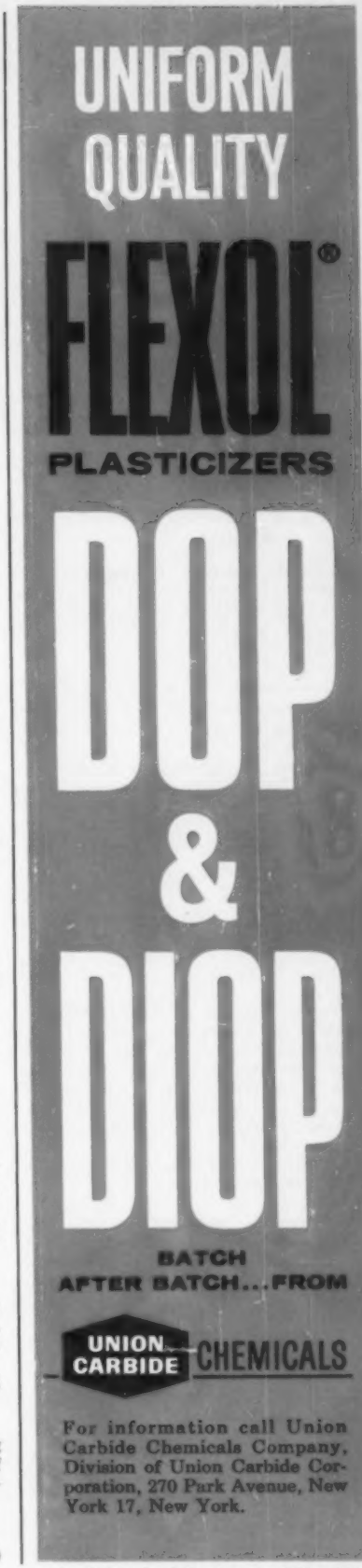
"Some Problems Concerning the Strength of Polymers," G. M. Bartenev, SOVIET PLASTICS, No. 9, p. 40 (Sept. 1961).

Review of methods for analysis and testing.

"Electrometric Method of Measuring the Volume and Surface Resistivities of Plastics," S. N. Antonov, SOVIET PLASTICS, No. 8, p. 52 (August 1961).

Brief description of the test method.

(Continued on page 70)



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Patent Digest

Materials

Production of Polystyrene from Styrene-in-Hydrocarbon Solution. No. 2,980,661. W. W. Twaddle, Hammond, R. W. Myerhlotz Jr., Highland, and D. E. Burney, Griffith, Ind. (to Standard Oil Co., Chicago, Ill.).

Polymerization of Olefins. No. 2,980,664. A. P. Stuart, Media, Pa. (to Sun Oil Co., Philadelphia, Pa.).

Fractionation of Polymers. No. 2,979,493. W. N. Axe and A. N. De Vault, Bartlesville, Okla. (to Phillips Petroleum Co.).

Low Temperature Polymerization of Ethylene. No. 2,979,496. P. Ehrlich, Hampden, Mass. and R. N. Pittilo, Texas City, Tex. (to Monsanto Chemical Co., St. Louis, Mo.).

Plastic Sheet Material. No. 2,980,574. A. B. Menzer, Joliet, Ill. (to Kemlite Corp., Joliet, Ill.).

Plastisol Composition Comprising a Thermoplastic Vinyl Resin and Filter Cake. No. 2,980,643. L. E. Edelman, Penn Twp., and J. W. Forbes, Jeannette, Pa. (to Westinghouse Electric Corp., E. Pittsburgh, Pa.).

Polymeric Compositions. No. 2,980,640. W. E. Shoemaker, Baden, and R. Macdonald Hookstown, Pa. (to Koppers Co., Inc.).

Ultraviolet Light Protected Poly-α-Olefin Compositions. No. 2,980,645. G. C. Newland and J. W. Tamblyn, Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.).

Stabilized Polyethylene. Nos. 2,980,646 and 2,980,647. G. R. Lappin, Kingsport, Tenn. (to Eastman Kodak Co., Rochester, N. Y.).

Polyamide-Epoxy Adhesive. No. 2,986,539 to Lester E. Schniepp, Raymond E. Mietz, and James H. Groves, Barrington, Ill. (to American Can Co., New York, N.Y.).

Copolymer of Methyl Methacrylate, Alkyd Resin and Modified Glycidyl Methacrylate and Coating Composition Comprising Same. No. 2,988,524 to Robert M. Fitch, Bala-Cynwyd, Pa. (to E. I. du Pont de Nemours & Co., Inc., Wilmington, Dela.).

Aliphatic-9-Fluorene-Plasticized Vinyl Resin Compositions. No. 2,986,545 to John T. Fitzpatrick, Charleston, and Samuel W. Tinsley, South Charleston, W. Va. (to Union Carbide Corp., New York, N.Y.).

Processing

Method of Molding a Plastic Jacket Around a Plurality of Inserts. No. 2,975,482. David L. Babcock, Rochester, N.Y. (to the United States of America as represented by the Secretary of the Navy).

Molding of Thermoplastic Materials. No. 2,975,487. George H. Williams, Jr., Cranford, N.J. (to Bell Telephone Laboratories, Inc.).

Process for Producing Polymeric Pellets by Cutting Surface Cooled Strands. No. 2,975,483. Paul Duncan Cooper and Zygmunt Stephen Zimny, Chattanooga, Tenn. (to E. I. du Pont de Nemours & Co., Inc.).

Process for Producing Films. No. 2,975,484. Leonard Edward Amborski, Buffalo, N.Y. (to E. I. du Pont de Nemours & Co., Inc.).

Room Temperature Laminating Composition and Method of Making Laminated Products. No. 2,977,273. Otto Hans Korican, Baltimore 17, Md.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Prices 25c each.

Abstracts of Important Articles (Cont'd.)

"Polymers Based on the Condensation Products of Furfural with Acetone. I. Preparation of Furfurylidene and Difurfurylidene Acetone and Resins made from them in the Presence of an Alkyline Catalyst," I. V. Kamenskii & N. V. Ungurean, SOVIET PLASTICS, No. 8, p. 17 (August 1961).

Polymerization is shown to occur as a result of condensation.

"Mechanical Testing of Plastics. II. Static Testing," S. B. Ratner, SOVIET PLASTICS, No. 8, p. 47 (August 1961).

Review of the subject, with emphasis on test specimens.

"Vapor Pressure of Certain Organosilicon Compounds," V. V. Popov, SOVIET PLASTICS, No. 8, p. 25 (August 1961).

Brief listing of boiling points and vapor pressure constants.

"The Use of Plastics in Representing Processes in Materials being Worked Under Stress," B. N. Bobrynin, SOVIET PLASTICS, No. 8, p. 26 (August 1961).

Plastics are shown to be applicable in studying deformation of solids.

"The Microstructure of Tubes made by Winding Anisotropic Fibreglass Material," K. M. Ivanov & O. N. Gazizova, SOVIET PLASTICS, No. 8, p. 27 (August 1961).

Method is presented for improving tubes during their manufacture.

"Adhesion of Polymers to Glass Fibres of Various Chemical Compositions," M. S. Asianova, SOVIET PLASTICS, No. 8, p. 30 (August 1961).

Test results show that the better the properties of the glass fibers, the better is their adhesion.

"Thermal and Physical Properties of Highly Carbonized Polymers," V. K. Zamoluev, SOVIET PLASTICS, No. 8, p. 41 (August 1961).

A study of properties of polymers obtained by heat treatment of coals.

"Contributions to the Analytical Chemistry of Plastics. XIV. Analyses of Binary and Ternary Copolyamides. E. Schroeder, PLASTE U. KAUTSCHUK, 8, 3, 121. (Mar. 1961).

The procedures which were developed for analyzing binary and ternary copolyamides from hexamethylene diamine adipate and sebacate; from capprolactam, and omega-aminoundecanoic acid are described. (In German.)

"High Density Polythene Monofilament," E. Overgage and G. John, BRIT. PLASTICS, 34, 1, 10 (Jan. 1961).

Review of manufacture, properties, and applications.

"Stress Distribution in the Resin of Reinforced Plastics," J. O. Outwater and D. C. West, MODERN PLASTICS, 39, 1, 154 (Sept. 1961).

Stresses are examined by means of photoelastic techniques.

"The Effects of Radiation on Plastics. Part I—Polystyrene and Related Materials," Arthur Bradley, PLASTICS DESIGN PROCESS, Pg. 18 (Nov. 1961).

Description of work being done by Radiation Research Corp.

"Diallyl Isophthalate Resins for Molding —How They Differ from DAP Resins," J. L. Thomas, PLASTICS DESIGN PROCESS, Pg. 25 (Nov. 1961).

A short review of the resins and their differences from DAP resins.

"Stabilizing Plastics Against Ultraviolet Degradation," F. R. Hansen and R. A. Buckley, PLASTICS WORLD, 16, 1, 14 (Nov. 1961).

A comparison of several basic approaches to solution of the problem.

"New Light on Melt Elasticity," R. A. McCord and Bryce Maxwell, MODERN PLASTICS, 39, 1, 116 (Sept. 1961).

Large amounts of recovery from strains demonstrate that melts are very elastic.

"Mechanical Testing of Plastics. III. Fatigue Tests," S. B. Ratner, A. V. Stinskas, & G. Gilgendorf, SOVIET PLASTICS, No. 9, p. 45 (Sept. 1961).

Part 3 of a five-part report.

"Mechanical Testing of Plastics. IV. Wear," S. B. Ratner & I. I. Farberova, SOVIET PLASTICS, No. 9, p. 51 (Sept. 1961).

The fourth part of this comprehensive review.

"Mechanical Testing of Plastics. V. Heat Resistance," S. B. Ratner, M. D. Frenkel, & A. V. Novozhilov, SOVIET PLASTICS, No. 9, p. 57 (Sept. 1961).

The concluding portion of this review.

"The Free Expansion of P.V.C. Using Azodicarbonamide," D. J. Cram, C. M. Lavender, R. A. Reed and A. Schofield, BRIT. PLASTICS, 34, 1, 24 (Jan. 1961).

Survey of expansion using azodicarbonamide.

"The Elmendorf Tear Test for Thin Unsupported P.V.C. Sheet," N. Stackhouse, BRIT. PLASTICS, 34, 1, 34 (Jan. 1961).

Brief description of the test method and apparatus.

"Laminated Plastics Based on Fiberglass. XI. Effect of Monomer Content on the Properties of Unsaturated Polyester Resins and of Fiberglass Plastics with a Polyester Binder," P. Z. Li, Z. V. Mikhailova & L. N. Sedov, SOVIET PLASTICS, No. 8, P. 9 (August 1961).

Test results confirm ideas set forth by other investigators.

"The Epoxy Resins," J. R. Gray, PROGRESSIVE PLASTICS, Pg. 47 (Nov. 1961).

This part 3 of the article deals with long-time loading, adhesives, etc.

Article Reference System

Plastics Technology 6, 9, 54 means the article appears in Vol. 6, No. 9, page 54. Send requests for copies, reprints or further information to the editor of the magazine where the article appears. (A list of publications and their addresses appears in Plastics Technology in January, April, July and October.)

"A New Catalyst for Urethane Foams," Herman Stone, E. A. Dickert, and J. S. Dunwoodie, SPE J., 17, 11, 1199 (Nov. 1961).

Evaluation of a chelated stannous catalyst.

"Hardness of Polymeric Materials," Eric Baer, R. E. Maier, and R. N. Peterson, SPE J., 17, 11, 1203 (Nov. 1961).

Description of an empirical test procedure related to basic properties.

"Thermal Stability of Silicone Resins Containing p-Phenylenedisilanes," L. W. Breed, SPE J., 17, 11, 1206 (Nov. 1961).

Method for screening small resin quantities for ultimate flexural strength tests.

"Comparison of Spiral-Cavity Mold Flow with Laboratory Scale Flow Tests on Thermoplastics," J. J. Gouza and G. G. Freygang, SPE J., 17, 11, 1211 (Nov. 1961).

Comparison of typical acrylic, modified acrylic, polystyrene, and cellulose acetate-butyrate molding powders.

"Strength of Plastics—I. Types of Failure," P. I. Vincent, PLASTICS (LONDON), 26, 288, 121 (Oct. 1961).

The beginning of a series on mechanical properties and their testing.

"Some Aspects of P.V.C. Stabilization and Degradation," G. M. Dyson, J. A. Horrocks, and A. M. Fernley, PLASTICS (LONDON), 26, 288, 124 (Oct. 1961).

A discussion of chemical reactions with metal soap stabilizers.

"A New Technique of Testing Resin/Glass Laminates — Conclusion," K. J. Brookfield, D. Pickthall, and R. S. Warburton, PLASTICS (LONDON), 26, 288, 151 (Oct. 1961).

The conclusion of a series on testing properties and their use in design.

"Cold-Formed Polycarbonate Resin—Properties and Applications," Geza Gruenwald, MODERN PLASTICS, 38, 1, 137 (Sept. 1961).

Review of properties and potential applications.

"New Epoxides for Plastics and Coatings," G. A. Trigaux, MODERN PLASTICS, 38, 1, 147 (Sept. 1961).

Discussion of four cycloaliphatic diepoxides and their reactions.

"Properties of a New Polyester Film," M. T. Watson, SPE J., 17, 10, 1083 (Oct. 1961).

Properties of Kodel film are compared with those of other terephthalic films.

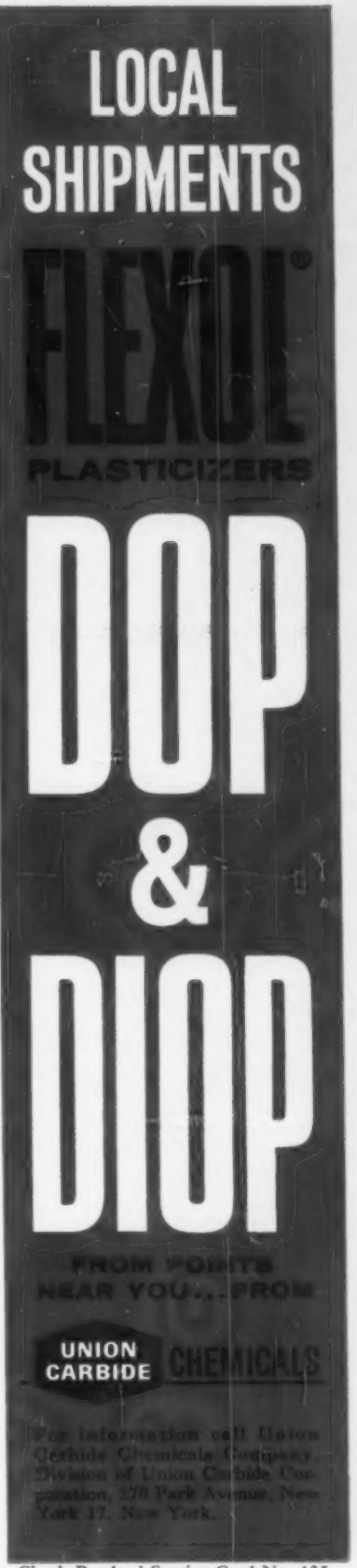
"Flame Retardance in Plastics," C. H. Carpenter and G. P. Mack, BRIT. PLASTICS, 34, 10, 541 (Oct. 1961).

Short note on using additives to retard flame effect.

"Permeability of Plastics," I. Phillips and D. V. Bartlett, BRIT. PLASTICS, 34, 10, 533 (Oct. 1961).

Description of work on measuring permeability constants.

(*Continued on next page*)



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Abstracts of Important Articles (Cont'd.)

Equipment

"Determining the Output from a Single-Screw Extruder, Taking Friction and Back Pressure into Account," R. M. Kruglikov & S. M. Rips, SOVIET PLASTICS, No. 8, p. 45 (August 1961).

A nomograph is given, together with instructions for its application.

"A Guide to Winding—Part 2," S. F. Oakes and A. A. Arterton, MODERN PLASTICS, 38, 1, 124 (Sept. 1961).

This section covers clutches, web guides, trimmers, trim handlers, treaters, wrinkle eliminators, web transfer, and other accessory equipment.

"New Instrument for Pre-Treating Polyethylene Moldings," H. Frohlich, KUNSTSTOFFE, 51, 10, 657 (Oct. 1961).

An automatic instrument for improving surface properties of moldings.

"Methods and Types of Instruments Used for Welding Thermoplastic Film," U. Kriebel, KUNSTSTOFFE, 51, 10, 665 (Oct. 1961).

A survey of all welding instruments for film.

"Injection Molding Tool for Tablet Tubes," H. Gastrow, KUNSTSTOFFE, 51, 10, 678 (Oct. 1961).

Description of a tool for injection molding of the tubes.

"Selection of an Extruder Gear Reducer," John Williams, CANAD. PLASTICS, Pg. 46 (Oct. 1961).

Factors to be considered when planning purchase of an extruder.

"How to Select a Vacuum System for Thermoforming," P. F. Charles, MODERN PLASTICS, 39, 2, 105 (Oct. 1961).

Discussion of reservoir and pump sizing procedures.

Applications

"Plastics in Agriculture," J. Soyeur, PENSEZ PLASTIQUES, No. 230, p. 38 (First quarter 1961).

Among new French developments mentioned is a small, portable, protective frame made of laminated polyester. Progress in the use of flexible polyethylene film for greenhouses, and for other purposes in Tunis, Gabon, and Italy is also described. (In French.)

"Possible Applications of Glass-reinforced Plastics Chains, and Calculation of Lifting Strength," H. Gut, KUNSTSTOFF-RUNDSCHAU, 8, 3, 115 (March 1961).

The links of standard plastics hoisting chains made by a German firm have outer shells of polystyrene over a glass/polyester laminate; other types of chains have epoxy resin cores with shells of Makrolon (polycarbonate), PVC, or polyethylene. (In German.)

"Fiberglass Slide Rule for the Planning Engineer," H. Gut, PLASTVERARBEITER, 12, 3, 99 (Mar. 1961).

The use of a slide rule designed for determining loss of heat of fiberglass insulated walls is described. (In German.)

"Glass-Reinforced Polyester Resins for the Construction of Containers," W. Schulte-Huermann, PLASTVERARBEITER, 12, 3, 86 (Mar. 1961).

The factors to be considered in the construction of these containers (types of resin and reinforcing material; shape, size, and number of containers; chemical resistance) are discussed and illustrated by examples. (In German.)

"Molding vs. Casting for Epoxy Encapsulation," G. B. Rugg, MODERN PLASTICS, 39, 1, 109 (Sept. 1961).

Comparison of methods for certain electrical applications.

Directory

1 time	$22.00 per inch
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12 times	$18.00 per inch

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CALENDAR of COMING EVENTS

January 30-February 2
SPE 18th ANTEC. Penn-Sheraton Hotel, Pittsburgh, Pa.

February 6-8
SPI 17th Reinforced Plastics Division Conference. Edgewater Beach Hotel, Chicago, Ill.

February 19-22
NCAEI Fourth Insulation Conference. Shoreham Hotel, Washington, D. C.

March 6-7
Society of Vacuum Coaters. 5th Annual Technical Conference. Sheraton-Cleveland Hotel, Cleveland, O.

March 13-14
MCA Symposium on Packaging of Chemical Products, St. Louis, Mo.

March 20-29
American Chemical Society. 141st National Meeting. Washington, D. C.

April 4-6
SPI 19th Western Section Conference. Hotel del Coronado, Coronado, Calif.

April 13-22
International Plastics Fair, Zagreb, Yugoslavia

April 17
SPE Philadelphia Section RETEC. Polypropylene's Expanding Position in Plastics. Sheraton Hotel, Philadelphia, Pa.

April 30-May 3
ASME Design Engineering Conference and Show, Chicago Exposition Center, Chicago, Ill.

May 10-11
SPE Newark Section Workshop. Encapsulation: Materials and Techniques. Military Park Hotel, Newark, N. J.

May 28-29
SPI 20th Canadian Section Conference. Chateau Frontenac, Quebec City, Que., Can.

May 19-29
Europlastique 62. Terrace R, Exhibition Park, Paris, France.

June 6-7
Joint ASTM-Navy Symposium on Standards for Filament-Wound Reinforced Plastics, Naval Ordnance Laboratory, Silver Spring, Md.

June 10-14
ASME Summer Annual Meeting, Quebec, Can.

June 12-22
International Plastics Exhibition, Olympia, London, England.

July 17-19
Western Packaging Exposition, Brooks Hall, San Francisco, Calif.

Domestic Production and Sales of Plastics and Resin Material, July and August, 1961

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of July, and August, 1961. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

	July, 1961		August, 1961	
	Production	Sales	Production	Sales
Cellulose Plastics:				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,386,582	1,511,932	1,492,388	1,442,104
Sheets, 0.003 gage and over	2,139,997	2,084,478	3,092,160	2,947,297
All other sheets, rods, and tubes (including other cellulose plastics)	424,266	412,909	418,591	526,169
Molding and extrusion materials (including cellulose plastics)	6,460,602	5,676,877	6,588,081	8,012,352
Nitrocellulose sheets, rods, and tubes	53,970	—	84,403	82,175
TOTAL	10,465,419	9,686,196	11,675,623	13,010,097
Phenolic and Other Tar-Acid Resins:				
Molding materials	12,484,428	11,712,807	17,823,353	17,056,970
Bonding and adhesive resins for—				
Laminating (except plywood)	5,393,554	3,359,422	7,492,361	4,796,740
Coated and bonded abrasives	821,265	836,425	1,555,443	1,453,909
Friction materials (brake linings, clutch facings, and similar materials)	1,447,476	1,254,129	1,526,044	1,479,157
Thermal insulation (fiber glass, rock wool)	7,014,559	3,276,961	7,782,989	3,613,887
Plywood	5,404,312	4,718,218	4,390,982	4,855,402
Fibrous and granulated wood	379,944	403,696	289,209	539,180
All other bonding and adhesive uses	4,190,823	4,502,196	5,996,842	5,808,379
Protective-coating resins unmodified and modified except by rosin	1,637,985	1,432,271	1,727,702	1,317,241
Resins for all other uses	2,619,521	2,880,941	3,520,851	2,994,089
TOTAL	41,393,867	34,377,086	52,105,776	43,914,954
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	2,120,082	1,841,648	3,097,061	2,531,358
Paper-treating and paper-coating resins	2,151,533	2,313,216	2,817,818	2,859,056
Bonding and adhesive resins for—				
Laminating	2,170,819	2,147,478	4,077,037	3,021,865
Plywood	6,834,995	7,119,742	9,001,015	8,695,974
All other bonding and adhesive uses	3,633,686	3,016,908	3,685,561	3,583,267
Protective-coating resins, straight and modified	2,805,031	1,706,632	3,624,297	2,306,951
Resins for all other uses, including molding	5,998,148	7,568,567	9,367,657	9,806,215
TOTAL	25,714,294	25,714,191	35,670,446	32,804,686
Styrene Resins:				
Molding and extrusion materials:				
Straight polystyrene	28,010,741	18,439,249	29,808,357	26,063,787
All other	35,377,513	28,873,255	36,932,886	33,946,388
Protective-coatings	6,089,155	4,510,732	5,291,032	4,450,811
Textile and paper treating and coating resins	6,055,461	4,183,280	5,861,302	4,756,407
All other uses	13,251,591	18,857,423	15,821,871	20,817,277
TOTAL	88,784,461	74,863,939	93,715,448	90,034,670
Vinyl and Vinyl Chloride Resins:				
Polyvinyl chloride and copolymer resins (50% or more PVC) for—				
Film (including calender coating)	—	6,769,452	—	7,617,701
Sheeting (including calender coating)	—	8,867,962	—	12,420,423
Molding and extrusion	—	21,668,932	—	29,264,153
Textile and paper treating and coating (including paste coating)	—	4,396,106	—	6,462,366
Flooring	—	12,826,980	—	17,810,699
Protective coating	—	3,160,329	—	3,980,653
All other uses	—	8,783,619	—	11,391,170
All other vinyl resins for—				
Adhesives	—	4,857,352	—	6,035,490
Protective coatings	—	2,737,050	—	2,165,261
All other uses	—	10,358,721	—	10,595,663
TOTAL	91,943,286	84,426,503	107,232,991	107,743,579
Coumarone-Indene and Petroleum Polymer Resins	16,532,933	17,235,556	21,561,934	21,986,730
Polyester Resins:				
For reinforced plastics	9,218,221	9,576,519	10,827,296	10,110,425
For all other uses	2,779,219	1,897,391	2,556,565	1,896,766
TOTAL	11,997,440	11,473,910	13,383,861	12,007,191
Polyethylene Resins:				
For film and sheeting	—	40,906,943	—	46,284,621
Molding materials	—	20,137,335	—	23,195,948
Extrusion materials	—	13,594,785	—	17,513,477
For all other uses	—	14,806,305	—	18,126,465
Sales for export	—	27,364,417	—	32,648,197
TOTAL	135,352,607	116,809,785	133,977,320[1]	137,768,708[2]
Polypropylene Resins	7,163,246	5,175,956	9,053,218	7,044,139
Epoxy Resins:				
For protective coatings	—	1,775,703	—	2,146,474
For all other uses	—	2,303,388	—	3,386,556
TOTAL	5,488,424	4,079,091	5,304,777	5,533,030
Silicone Resins	—	447,370	677,540	675,181
Miscellaneous Synthetic Plastics and Resin Materials	21,128,174	19,396,150	25,242,267	22,654,180
GRAND TOTALS	455,973,551[3]	403,685,733[4]	509,601,201	495,177,145

[1] 18.4% produced by low-pressure process.
[2] 16.5% of sales produced by the low-pressure process.
[3] Does not include silicone resin production which was not available.
[4] Does not include nitrocellulose sheets, rods, and tubes sales which was not available.
SOURCE: United States Tariff Commission Chemical Division.

current market prices

Prices in general are f.o.b. works. Ranges indicates variations in grade, quality, quantities, and geographical locations of customers. No guarantee of these prices is made, and spot prices should be obtained by contacting this publication.

Catalysts

Ammonium thiocyanate	lb.	$0.1725 /	$0.26
Peroxide, acetyl, 25% in DMP	lb.	1.75 /	4.00
Benzoyl, dry, 96%	lb.	.88 /	2.00
Wet, 50% paste in TCP	lb.	.89 /	2.25
In silicone fluid	lb.	2.75 /	5.00
55% in BBP	lb.	.89 /	2.25
Caprylyl, liquid, 50% in mineral oil	lb.	4.45 /	5.50
In DOP	lb.	5.00	
Cyclohexanone, 45% paste in DBP	lb.	2.00 /	3.00
Powder, 85%, in DBP	lb.	3.00 /	4.00
p-Chlorobenzoyl, paste, 50%			
In mineral oil	lb.	4.25 /	5.00
In TCP	lb.	5.00	
2,4-Dichlorobenzoyl, 50% in silicone oil	lb.	2.00 /	4.25
40% in silicone oil	lb.	4.25 /	6.00
Di-t-butyl	lb.	1.75 /	4.00
Lauroyl	lb.	1.55 /	3.50
Other peroxides	lb.	1.55 /	5.00

Colorants

Black, std.	lb.	.90 /	4.10
Carbon black	lb.	0575/	.87
Paste	lb.	.65 /	.74
Bone blacks	lb.	.155 /	.2775
Colloidal dispersions	lb.	.66 /	1.45
Aqueous	lb.	.115 /	.395
Gel coats	lb.	.61 /	.86
Iron oxide	lb.	.1275/	.23
Lampblack	lb.	.1225/	.175
Masterbatch	lb.	.60 /	.63
Paste (for epoxies)	lb.	1.58 /	2.15
(for vinyls)	lb.	.50 /	.66
Paste dispersion	lb.	.85 /	1.90
Paste concentrate	lb.	.82 /	1.20
Pigment dispersion	lb.	.83 /	1.15
Blue, std.	lb.	.90 /	2.75
Concentrate	lb.	.93 /	3.00
Masterbatch	lb.	.85 /	1.13
Pearl	lb.	1.38	
Metallic	lb.	.02	
Paste (for epoxies)	lb.	1.25 /	2.60
(for vinyls)	lb.	.62 /	1.84
Paste dispersion	lb.	.85 /	2.40
Paste concentrate	lb.	.78 /	.80
Phosphorescent	lb.	.24	
Brown, std.	lb.	.87 /	4.00
Copper tinsel	lb.	.10	
Gel coats	lb.	.59 /	1.04
Iron oxide	lb.	.15 /	.24
Metallic bronze	lb.	.02	
Paste (for epoxies)	lb.	1.18 /	1.47
(for vinyls)	lb.	.48 /	1.67
Paste dispersions	lb.	.75 /	1.70
Paste concentrate	lb.	.65 /	2.30
Gold, metallic	lb.	.21	
Paste dispersions	lb.	1.40 /	1.60
Tinsels	lb.	.10	
Gray, gel coat	lb.	.59 /	.84
Paste (for epoxies)	lb.	1.40	
Paste dispersion	lb.	1.45 /	2.20
Green, std.	lb.	.90 /	3.25
Chromic oxide	lb.	.45 /	1.40
Concentrate	lb.	.93 /	3.00
Masterbatch	lb.	1.20 /	1.23
Metallic	lb.	.21	
Paste (for epoxies)	lb.	2.86	
(for vinyls)	lb.	.80 /	1.83
Dispersions	lb.	.85 /	2.70
Concentrate	lb.	.80 /	2.15
Pearl	lb.	.10	
Phosphorescent	lb.	.24	
Orange, dry	lb.	.49 /	3.50
Gel coat	lb.	.75 /	1.05
Lithopone	lb.	1.63 /	1.86
Paste (for epoxies)	lb.	1.58	
(for vinyls)	lb.	.74 /	4.27
Concentrate	lb.	1.58	
Dispersion	lb.	.55 /	2.80
Purple, pearl	lb.	.10	
Red, std.	lb.	.1425/	5.00
Cadium lithopone	lb.	1.90 /	2.86
Selenide	lb.	4.60 /	7.15
Concentrate	lb.	2.25 /	2.50
Iron oxide	lb.	.0475/	.205
Metallic	lb.	.021	
Masterbatch	lb.	.75 /	.88
Paste (for epoxies)	lb.	2.35 /	3.77
(for vinyls)	lb.	1.20 /	3.82
Concentrate	lb.	5.42 /	6.49
Dispersions	lb.	.90 /	3.05
Venetian	lb.	.065 /	.1325
Silver, metallic	lb.	.0165	
Paste (for epoxies)	lb.	1.55	
(for vinyls)	lb.	.89 /	.91
Dispersion	lb.	$0.85 /	$1.45
Concentrate	lb.	1.02	
Tinsels	lb.	.10	
Yellow, std.	lb.	.12 /	3.50
Cadium lithopone	lb.	1.21 /	1.29
Concentrate	lb.	1.40 /	2.50
Gel coat	lb.	.61 /	1.03
Iron oxide	lb.	.1225/	.1875
Masterbatch	lb.	.90 /	.93
Paste (for epoxies)	lb.	2.15 /	2.55
(for vinyls)	lb.	.58 /	3.70
Concentrate	lb.	.65 /	2.87
Dispersions	lb.	.90 /	2.20
White, std.	lb.	.54 /	4.00
Concentrate	lb.	.70 /	1.25
Gel coat	lb.	.59 /	.84
Masterbatch	lb.	.75 /	.80
Paste (for epoxies)	lb.	1.02	
(for vinyls)	lb.	.48 /	.60
Concentrate	lb.	.705 /	.725
Dispersion	lb.	.70 /	2.00
Pearl	lb.	.10	

Fillers

Aluminum silicate pigments	ton	21.50 /	65.00
Barytes	ton	60.00 /	123.00
Paste concentrate	lb.	.705 /	.725
Calcium carbonate, ppt	ton	30.00 /	187.00
Std.	ton	15.00 /	35.00
China clay	ton	40.00	
Flours	ton	50.00 /	106.00
Flocks, cotton	lb.	.12 /	.30
Rayon	lb.	.50 /	1.25
Nylon	lb.	.35 /	2.75
Mica	lb.	.075 /	4.44
Silica	ton	25.00 /	48.50
Whiting	ton	8.75 /	13.25
Oyster shell	ton	30.00	
Wollastonite	ton	29.00 /	47.50

Miscellaneous

Anti-Fog	gal.	8.69 /	16.95
Anti-Static	gal.	3.57 /	8.50
(for films)	gal.	8.00 /	8.50
Odorants	lb.	1.25 /	10.00
Purging cmpd. (for injection)	lb.	.40	
Wetting agent (for dry coloring)	gal.	2.50 /	3.20
(for wet operations)	lb.	2.59 /	3.69

Mold Release Agents

Silicone type: Cmpds	lb.	4.70 /	5.20
Aerosols	20 oz. can	.80 /	1.00
Emulsions	lb.	1.09 /	1.65
Solvent type	lb.	.40 /	4.95
Fluids	lb.	2.74 /	6.00
Stearates: Barium	lb.	.41 /	.46
Calcium	lb.	.39 /	.44
Magnesium	lb.	.42 /	.47
Zinc	lb.	.41 /	48

Plasticizers

Adipate, Butyl Cellosolve	lb.	.43 /	.47
Dibutoxyethyl	lb.	.425 /	.46
Didecyl	lb.	.265 /	.375
Diisodecyl	lb.	.35 /	.385
Diisobutyl	lb.	.41 /	.44
Diisooctyl	lb.	.35 /	.435
Dioctyl	lb.	.35 /	.385
2-Ethyl hexyl	lb.	.35 /	.435
Isooctyliisodecyl	lb.	.40 /	.435
Isooctyl	lb.	.49 /	.535
n-Octyl decyl	lb.	.39 /	.44
Azelate, dioctyl	lb.	.41 /	.49
Di-2-ethyl hexyl	lb.	.40 /	.465
Dibenzoate, Diethylene glycol	lb.	.26 /	.275
Dipropylene glycol	lb.	.23 /	.275
Triethylene glycol	lb.	.60 /	.70
Epoxy, polymeric	lb.	.3225/	.3525
Monomeric	lb.	.3475/	.3775
Ester, Fatty Acid	lb.	.3525/	.3775
Monomeric	lb.	.35 /	.60
Laurate, Butoxyethyl	lb.	.39 /	.40
Oleate, Butyl	lb.	.24 /	.37
Butoxyethyl	lb.	.30 /	.33
Methoxyethyl	lb.	.31 /	.34
Phosphate, Tributyl	lb.	.50 /	.535
Tricresyl	lb.	.325 /	.36
Phthalate, Butyl Cellosolve	lb.	.345 /	.385
Butyl octyl	lb.	.22 /	.30
Cyclohexyl	lb.	.225 /	.305
Isodecyl	lb.	$0.22 /	$0.28
Butoxyethyl	lb.	.365 /	.375
Dibutyl	lb.	.28 /	.325
Dicapryl	lb.	.265 /	44
Dicyclohexyl	lb.	.475 /	.59
Didecyl	lb.	27	
Diisodecyl	lb.	.23	.45
Diisooctyl	lb.	.225 /	.445
Dioctyl	lb.	.235 /	.305
Isooctyldecyl	lb.	.24 /	.28
Methoxyethyl	lb.	.355 /	.405
Polyester type	lb.	.34 /	.7125
Polymeric type	lb.	.32 /	.935
High-solvating	lb.	.37 /	.425
Ricinoleate type	lb.	.32 /	.35
Sebacate, Dibenzyl	lb.	.91 /	1.04
Dibutyl	lb.	.655 /	.785
Dioctyl	lb.	.57 /	.6825
Soy Bean oil, epoxized	lb.	.3235/	.4775
Stearate, Butyl	lb.	.235 /	.395
Butoxyethyl	lb.	.31 /	.32
Epoxized octyl	lb.	.3475/	5325
Methoxyethyl	lb.	.32 /	35
Octyl epoxy	lb.	.3925/	.647
Tallate, Octyl epoxy	lb.	.3475/	4.025

Resins, Molding, Casting & Coating

ABS type	lb.	.42 /	1.16
Acetal	lb.	.65 /	93
Colors	lb.	.74 /	1.24
Acrylic	lb.	.46 /	1.08
Alkyd	lb.	.1325/	1.20
Allyl (diallyl phthalate)	lb.	95 /	2.50
Carbonate	lb.	1.30 /	2.25
Cellulosics:			
Cellulose acetate	lb.	36 /	.68
Reprocessed	lb.	25 /	36
Cellulose acetate-butyrate	lb.	40 /	.81
Reprocessed	lb.	35 /	.45
Cellulose propionate	lb.	40 /	.81
Ethyl cellulose	lb.	67	
Reprocessed	lb.	30	
Epoxy, liquid	lb.	.60 /	1.41
Solid	lb.	.51 /	1.31
Ethylene copolymers	lb.	.32 /	.95
Fluorocarbons	lb.	3.25 /	11.00
Furane	lb.	75 /	1.00
Liquid	lb.	32 /	44
Melamine	lb.	.57 /	.70
Coating solns	lb.	.3275/	.4375
Phenolic	lb.	.207 /	1.12
Coating solns	lb.	.308 /	.3825
Polyamide	lb.	.62 /	1.26
Coatings	lb.	.61 /	1.51
Graphite-filled	lb.	1.40 /	1.83
Heat-stabilized	lb.	1.09 /	1.55
Molybdenum sulfide-filled	lb.	1.10 /	2.07
Polycarbonate	lb.	1.30 /	2.29
Polyester, powder	lb.	.26 /	2.20
Coating	lb.	.0975/	.1275
Glass-reinforced	lb.	.41 /	.80
Polyethylene, low-density	lb.	.2375/	.615
Medium-density	lb.	.2375/	.6425
High-density	lb.	.275 /	1.59
Polypropylene	lb.	.42 /	1.17
Reprocessed	lb.	50	
Polystyrene	lb.	.18 /	1.34
Reprocessed	lb.	.15 /	.26
Rubber-modified	lb.	.20 /	.275
Polyurethane	lb.	1.30 /	7.50
Silicones, casting	lb.	7.80 /	11.40
Molding	lb.	2.40 /	3.55
Urea coating solns	lb.	.205 /	.27
Vinyl, dispersion grade	lb.	.24 /	.325
Copolymers	lb.	.2025/	.44
Molding	lb.	.185 /	.66
Nitrile rubber blend	lb.	.45 /	.53
Reprocessed	lb.	.19 /	.22
Vinyl-vinylidene copolymer	lb.	.185 /	.32
Vinylidene	lb.	.205 /	6.00
Latex	lb.	45 /	.52

Solvents

Ketones: Acetate	lb.	.08 /	.22
Methyl isoamyl	lb.	.175 /	.315
Esters: Ethyl acetate	lb.	.125 /	.2675
Isopropyl acetate	lb.	115 /	.255
n-Butyl acetate	lb.	145 /	.285
Alcohols: Isobutyl	lb.	13 /	.27
n-Butyl	lb.	.155 /	.295

Stabilizers

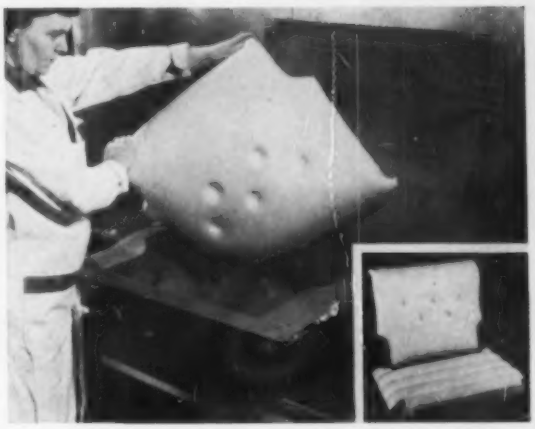
Alkyd tin mercaptide, liq.	lb.	2.50 /	3.15
Barium-cadmium complex:			
Liquid	lb.	.50 /	.58
Solid	lb.	.97 /	1.255
Barium-cadmium laurate	lb.	.87 /	.90
Myristate	lb.	.72 /	.75
Barium-cadmium-zinc complex	lb.	.54 /	.56
Barium-zinc, liquid	lb.	.58 /	.615
Powder	lb.	.375 /	.44
Complex	lb.	47 /	.50
Cadmium-barium, powder	lb.	.68 /	.895
Chelating agent, liquid	lb.	.57 /	.84
Cadmium-containing	lb.	.84 /	.87
Zinc-containing	lb.	62 /	.80
Organic complex, liquid	lb.	57 /	.84
Strontium-zinc laurate	lb.	72 /	.75
Zinc, liquid	lb.	.48 /	.52

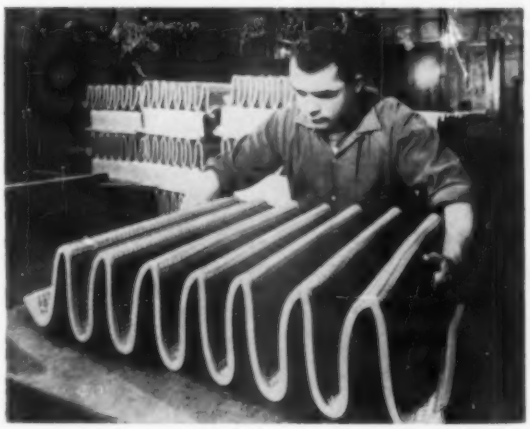
Foam Applications

Polyurethane cushions

Savings of more than one-third have been made by the Contour Chair-Lounge Co. of St. Louis by switching from conventional upholstering methods to the use of molded polyurethane foam components developed by the Bostrom Corp. of Milwaukee, Wis.

In the Bostrom method, the back section of the Contour chair is molded of polyether type foam in one piece with impressions for upholstery buttons as part of the mold. The deeply fluted seat section is also molded for Contour by Bostrom. Delivered to the furniture assembly line, they quickly fasten in place without the need for cutting, fitting, tacking or other conventional steps. According to Contour, the use of these molded components makes the firm competitive in the volume market for the first time in its history.





Foam air-filters

Improved performance of air filters in central ventilating systems is obtained by use of open cell polyurethane foam developed by Scott Paper Co., Foam Division, in Foamat filters made by American Filter Co., Louisville, Ky. The open cell foam, with a life expectancy of 15 years, has exceptional dust holding capacity in trapping a variety of airborne particles 3 to 5 microns and larger, while still permitting high air flow.

All Foamat filters are designed with a special pleat facing which increases the effective face area of the media. The foam is resistant to moisture and cleaning agents, and is chemically treated for permanent flame retardance. The units, which are mounted in aluminum frames, are washable and immediately reuseable without oiling or other treatment.

Urethane-foam walls

Prefabricated metal panels insulated with a new type of polyurethane plastic foam lowered construction costs of two new curtain wall buildings of Sylvania Electronics at Waltham, Mass. Two-thirds of the exterior walls, or about 50,000 square feet, are porcelainized steel panels laminated over a ¾-inch core of Foamthane, a freon-blown polyurethane-foam insulator recently introduced by Pittsburgh Corning Corporation.

According to the manufacturer of the panels, Seaporcel Metals, N.Y.C., the insulating effectiveness of Foamthane (K factor 0.15 at 70°F.) made possible approximately 50 percent reduction in panel thickness (fibrous glass or polystyrene-foam cores would have been 1½ inches thick). Vermin- and odor-proof and non-toxic Foamthane was laminated with neoprene contact adhesives.

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